

FORCHHEIMER'S THERAPEUSIS OF INTERNAL DISEASES

EDITED BY

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VOLUME II



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CONTENTS

I. INFECTIOUS DISEASES

CHAPTER I

TYPHOID FEVER

FREDERICK C. SHATTUCK

	PAGE
Prophylaxis	1
Vehicles of Transmission	1
Vaccination	3
Sera	7
Prevention of Extension	7
Carriers	9
Treatment	9
General Care	9
Diet	11
Hydrotherapy	16
Hemorrhage	19
Perforation	22
Circulation	23
The Lungs	24
The Genitourinary Tract	24
Gastric Irritability	25
Management of the Bowels	25
Insomnia	26
Headache	27
Nose-bleed	27
Parotitis	27
Periostitis, Orchitis	27
Mastitis	28
Otitis	28
Gall-bladder Affections	28
Phlebitis	28
Tender Toes	29
Typhoid Spine	29
Post-typhoidal Psychoses	29
Furunculosis	29
Treatment during Convalescence	29
References	30

CONTENTS

CHAPTER II

TYPHUS FEVER

ALVAN H. DOTY

	PAGE
Introduction	31
Methods of Transmission	32
Incubation	33
Symptoms	33
Treatment	36
Differential Diagnosis	38

CHAPTER III

SMALL-POX

JOHN RUHRÄH

Introduction	40
The Organism	41
The Infective Period	41
Transmission	42
The Incubation Period	43
Prophylaxis	43
Treatment	45
Diet	46
The Throat	47
Pain	47
Temperature	47
Suppuration and Delirium	48
Insomnia	48
The Eruption	48
The Eyes	50
Inflammation of the Larynx	51
Edema of the Glottis	51
Red Light Treatment	51
Potassium Permanganate Treatment	51
Serum Treatment	52
Small-pox Inoculation	52

CHAPTER IV

VACCINATION

JOHN RUHRÄH

The Pock Diseases of Animals	54
History of Vaccination	57
The Preparation of Vaccine Virus	62
The Technique	67
The Clinical History of Vaccination	70

CONTENTS

xi

	PAGE
Treatment of Ruptured and Infected Vaccinations	72
Indications for Vaccination	73
Influence of Vaccination on the Exanthems	74
Vaccination in Whooping-cough	74
Vaccination Scars	74
Revaccination	75
Insusceptibility	77
Immunity	77
Vaccination Complications and Accidents	78
Complications Due to the Vaccine Virus	80
Constitutional Complications and Skin Affections	87
The Value of Vaccination	92
Anti-vaccination Agitation	104
Summary	106
References	107

CHAPTER V

VARICELLA

JOHN RUHRÄM

Definition	109
History	109
Incubation and Transmission	110
Susceptibility and Immunity	110
Prophylaxis	111
Treatment	111
The Eruption	112
Diet	113
Convalescence	113

CHAPTER VI

SCARLET FEVER

J. P. CROZER GRIFFITH

Cause	114
Source of the Germs in the Body	115
Method of Dissemination and Persistence of Virulence	116
Period of Greatest Infectiousness	117
Mode of Entrance of the Germ	117
Preventive Treatment	118
Quarantine. Isolation	118
Prevention in Hospitals	121
Prevention in Schools	122
Prevention by Drugs	123
Preventive Inoculation	123
Treatment of the Attack	123
General Hygienic Measures	123

	PAGE
Treatment of the Attack (<i>Continued</i>)	
General Medical Treatment in Average Cases	124
Treatment of Convalescence	128
Serum Treatment	128
Treatment of Complications and Sequels	129
Affections of the Throat and Nose	129
Otitis	130
Cervical Adenitis	131
Gastrointestinal Complications	132
Arthritis	132
Nephritis	132
Respiratory Complications and Sequels	134
References	135

CHAPTER VII

MEASLES

FREDERICK FORCHHEIMER

Introduction	138
Prophylaxis	139
Treatment	145
Hygienic Treatment	145
Diet	148
Symptomatic Treatment	148
Hemorrhagic Form of Measles	154
Complications	156
Sequelæ	162
References	163

CHAPTER VIII

GERMAN MEASLES

FREDERICK FORCHHEIMER

Prophylaxis	164
Treatment	165

CHAPTER IX

MUMPS

JOHN RUHRÄH

General Considerations	166
Definition	166
Complications	166
History	167
Susceptibility	167
Transmission and Infectiousness	168

CONTENTS

xiii

PAGE

General Considerations (*Continued*)

Incubation	168
Prophylaxis	169
Treatment	169

CHAPTER X

WHOOPING-COUGH

JOHN RUHRÄH

General Considerations	173
Definition	173
Etiology	173
Prophylaxis	176
Treatment	177
Hygienic Measures	177
Diet	179
Use of Drugs	180

CHAPTER XI

INFLUENZA

WILLIAM H. SMITH

Introduction	184
Prophylaxis	185
Treatment	186
Specific Treatment	186
General Treatment	187
Treatment of Types	188
Complications	191
Convalescence	196
Summary	196
References	197

CHAPTER XII

CEREBROSPINAL MENINGITIS

CHARLES HUNTER DUNN

Etiology	199
Diagnosis of Meningitis	200
Serum Treatment in Cerebrospinal Meningitis	200
General and Symptomatic Treatment	211
References	214

CHAPTER XIII

LOBAR PNEUMONIA

HENRY L. ELSNER

	PAGE
Introduction	217
Statistics	218
Division of Cases for Therapeutic and Prognostic Purposes	219
Requisites of Treatment	219
Pneumonia, Old Age, and Childhood	220
Prophylaxis	220
Treatment of Sputum	221
Oral Cleanliness	221
Nurses and Attendants	222
Public Health	222
Correction of Predisposing Conditions	222
Carriers	222
Disinfection	222
Prevention of Secondary Pneumonia	222
Cleanliness	223
Education	223
Treatment	223
General Treatment	223
Diet	228
Hydrotherapy	231
Medicinal Treatment	233
Oxygen	236
Specific Treatment	237
Treatment of Cardiac Toxemia	246
Venesection	255
Treatment of Complications and Sequelæ	257
References	262

CHAPTER XIV

DIPHTHERIA

THOMAS DARLINGTON

Prophylaxis	266
Immunization	268
Treatment	268
Antitoxin Treatment	269
Local Treatment	271
Intubation	272
Medicinal Treatment, Diet, and Nursing	275
Complications	276
Tracheotomy	279

CONTENTS

xv

CHAPTER XV

ERYSIPELAS

GEORGE DOCK

	PAGE
Definition	281
Etiology	281
Predisposing and Assisting Causes	281
Pathologic Anatomy and Pathology	282
Symptoms	282
Complications and Sequels	283
Diagnosis	283
Prognosis	283
Treatment	283
Treatment of Complications	285

CHAPTER XVI

SEPTICOPYEMIA

GEORGE DOCK

Definition	286
Etiology	287
Pathology	287
Symptoms	287
Diagnosis	288
Prognosis	288
Treatment	289
Prophylactic Treatment	289
Surgical Treatment	289
Specific Treatment	289
Symptomatic Treatment	290

CHAPTER XVII

ACUTE RHEUMATISM

CHARLES LYMAN GREENE

Definition	292
Course and Development	292
Portals of Infection and Causative Agents	292
Treatment	296
Prophylaxis	296
Indications for Direct Treatment	296
Treatment by Drugs	298
Other Forms of Treatment	301
Treatment During Convalescence	301
Symptomatic Treatment	302
References	308

CHAPTER XVIII

ACUTE BACILLARY DYSENTERY

CHARLES WARREN DUVAL AND ISAAC IVAN LEMANN

	PAGE
General Introduction	316
Definition	316
Pathology	318
Prophylaxis	319
Geographical	319
Epidemiology	319
Bacilli Carriers	320
Agglutination Reaction	320
Treatment	321
Serum Treatment	321
Treatment Other Than Specific	323

CHAPTER XIX

ANTHRAX

WILLIAM H. PARK

Prophylaxis	330
Vaccine and Serum Treatment	331

CHAPTER XX

HYDROPHOBIA

WILLIAM H. PARK

Indications for Antirabic Treatment	334
Prophylaxis	335
Local Measures	336
Constitutional Measures	336
Treatment of the Developed Disease	342

CHAPTER XXI

TETANUS

WILLIAM H. PARK

The Use of Antitoxin	344
Method of Injecting Antitoxin	345
Single or Multiple Injections	346
Danger in Delay	346
Dose	346
Treatment of the Infected Area	347
Prevention	347

CONTENTS

xvii

	PAGE
Drug Treatment	347
General Measures	350
Feeding	350
Nursing	350
Results of Treatment	350
Preventive Treatment in Detail	350
Instructions	351
The Treatment of Actual Cases	351
References	356

CHAPTER XXII

GLANDERS

WILLIAM H. PARK

Glanders	357
References	358

CHAPTER XXIII

ACTINOMYCOSIS

WILLIAM H. PARK

Actinomycosis	359
-------------------------	-----

CHAPTER XXIV

THE GENERAL AND SPECIAL TREATMENT OF SYPHILIS

WILLIAM S. GOTTHEIL

Introduction	361
The Hygiene of the Syphilitic	364
Physical Hygiene	365
Nervous Hygiene	366
Sexual Hygiene	368
Hygiene of the Mouth	368
Alcohol and Tobacco	369
Influence of Other Local and General Maladies	370
The Prophylaxis of Syphilis	370
Factors Predisposing to Infection	370
Contagiousness of the Lesions and of the Normal Secretions	371
Modes of Contagion	371
Personal Prophylaxis	372
Public Prophylaxis	374
Marital Prophylaxis	376
The Abortive Treatment of Syphilis	376
Treatment	379
The Wassermann Reaction	379

	PAGE
Treatment (<i>Continued</i>)	
The Specific Medication	380
General Plan of the Constitutional Treatment	416
Local Treatment of the Syphilitic Lesions	421
Treatment of Syphilis in Pregnancy	431
Treatment of Hereditary Syphilis	432
Auxiliary Antiluetic Medication	435

CHAPTER XXV

TUBERCULOSIS

HERBERT MAXON KING

Prophylaxis	438
General Considerations	438
Predominant Characteristics of Antituberculosis Work in Various Countries	440
General Prophylactic Measures	451
Individual Prophylaxis	455
Treatment	468
General Considerations	468
Symptomatic Treatment	494
Drug Treatment	509
Tuberculin Therapy	510
Serotherapy	525
The Theory of Autoinoculation in Tuberculosis	525
Artificial Pneumothorax	535
Diet	538
Advice to Patients After Discharge from Treatment	559
References	560

CHAPTER XXVI

ROCKY MOUNTAIN SPOTTED FEVER

ED. E. MAXEY

Introduction	562
Prophylactic Treatment	563
General and Local Treatment	564
Serum Treatment	567
Convalescence	567
Summary	567
References	568

CHAPTER XXVII

WEIL'S DISEASE

ALLAN RAMSEY

Prophylaxis	570
Treatment	570

CONTENTS

xix

	PAGE
Treatment (<i>Continued</i>)	
General Treatment	571
Diet	571
Medication	572
Convalescence	573
References	573

CHAPTER XXVIII

GLANDULAR FEVER

ALLAN RAMSEY

Introduction	574
Prophylaxis	575
Treatment	576
Adenitis	576
Complications	577
References	577

CHAPTER XXIX

MILIARY FEVER

ALLAN RAMSEY

Introduction	578
Prophylaxis	579
Treatment	579
References	580

CHAPTER XXX

FOOT-AND-MOUTH DISEASE

ALLAN RAMSEY

Prophylaxis	581
Treatment	583
References	583

CHAPTER XXXI

PSITTACOSIS

ALLAN RAMSEY

Prophylaxis	584
Treatment	586
References	586

II. THE INTOXICATIONS

CHAPTER I

ALCOHOLISM

A. D. BLACKADER

	PAGE
Introduction	587
Varieties of Alcoholism	588
Acute Alcoholism	588
Chronic Alcoholism	590
Periodic Alcoholism	591
Prophylaxis	592
Treatment	593
Delirium Tremens	601
Treatment	602
Other Forms of Delirium	608
Acute Hallucinoses of Drunkards	608
Korsakow's Psychosis	609
Acute Wood Alcohol Poisoning	609
References	610

CHAPTER II

OPIUM POISONING—OPIUM AND MORPHIN ADDICTION

A. D. BLACKADER

Treatment of Acute Poisoning	614
Chronic Poisoning and Its Treatment	616
Chronic Opium or Morphin Intoxication	616
Treatment	617
References	625

CHAPTER III

PHOSPHORUS POISONING

A. D. BLACKADER

Introduction	626
Acute Poisoning	627
Treatment	627
Chronic Poisoning	628
Prophylaxis	629
Treatment	630

CONTENTS

xxi

CHAPTER IV

FOOD POISONING

A. D. BLACKADER AND ALBERT G. NICHOLLS

	PAGE
General Considerations	631
Special Forms of Food Poisoning	636
Poisoning by Eggs	636
Poisoning by Meat	637
Poisoning by Fish	643
Poisoning by Milk and Milk Products	645
Poisoning by Food of Vegetable Origin	647
Poisoning Due to Fungi	652
References	653

CHAPTER V

PELLAGRA

EDWARD JENNER WOOD

Prophylaxis	657
Treatment	659
References	663

CHAPTER VI

INTESTINAL AUTOINTOXICATION

HOWARD S. ANDERS

Introduction	664
Digestive Juices and Secretions	666
Normal Products of Digestion	666
Abnormal Products of Digestion	666
Normal Products of Bacterial Disintegration of Food	667
Abnormal Products of Bacterial Disintegration of Food	667
Treatment	668
Anti-putrefactive Diet	669
Elimination	671
Intestinal Antiseptics	674
Treatment of Conditions and Symptoms Associated with Intestinal Autoin-	
toxication	675
Habits of Living	675
Habitual Constipation	677
The Liver	679
Circulatory Disorders	679
Anemias	680
Metabolic Disorders	680
Respiratory Disorders	681
Nervous System	681
Ocular Affections	682
Cutaneous Disorders	682

III. CONSTITUTIONAL DISEASES

CHAPTER I

DISEASES OF THE MUSCLES

CHARLES LYMAN GREENE

	PAGE
Various Forms of Myositis	684
Acute Polymyositis	684
Syphilis of the Muscles	685
Primary Acute Suppurative Myositis	686
Secondary Suppurative Myositis	687
Tuberculous Myositis	687
Myositis Fibrosa	687
Myositis Ossificans	687
Muscular Rheumatism	688
Treatment	688
Muscular Cramps	689
Treatment	689
References	689

CHAPTER II

GOUT

CHARLES LYMAN GREENE

Definition	692
Etiology	693
Symptoms	695
Treatment	697
Prophylactic Treatment	697
Dietetic Management	699
Exercise	700
Hydrotherapy and Health Resorts	701
The Treatment of Acute Gout	701
Drug Treatment of Chronic Gout	703
References	704

CHAPTER III

ARTHRITIS DEFORMANS AND SO-CALLED CHRONIC RHEUMATISM

CHARLES LYMAN GREENE

Atrophic Arthritis	707
Hypertrophic Arthritis	708
Infectious or Toxemic Arthritis	709
Static Ailments	709
Still's Disease	710

CONTENTS

xxiii

	PAGE
Spondylitis	710
Chronic Gouty Arthritis	710
Therapy	710
Hygienic Treatment	711
Diet	711
Hydrotherapy	712
Drugs	713
Surgical Treatment	714
References	714

CHAPTER IV

DIABETES MELLITUS

DAVID RIESMAN

Introduction	717
Frequency	718
Pathogenesis	719
The Hyperglycemia of Diabetes	722
The Energy Requirements in Diabetes	724
Sources of Sugar	725
Transient Glycosuria	726
General Characteristics of Diabetic Urine	727
Prognosis	729
Prophylaxis	730
Diabetic Acidosis and Diabetic Coma	731
Tests for the Acetone Bodies: Qualitative Tests	732
Treatment	734
General Principles	734
Dietetic Regimen of Diabetic Cases in Practice	750
Treatment of Acidosis	756
Treatment of Diabetic Coma	757
Summary of Dietetic Treatment	758
Drugs in Diabetes	759
Hydrotherapy	762
Health Resorts for Diabetics	762
Exercise in Diabetes	763
Temperature	764
Treatment of Special Symptoms	764
Diabetes and Tuberculosis	767
Diabetes and the Thyroid Gland	767
Diabetes and Syphilis	768
Diabetes in Pregnancy	768
Diabetes in Children	768
Diabetaphobia	768
May Diabetics Marry?	769
Surgical Operations in Diabetic Patients	769
References	771

CHAPTER V

DIABETES INSIPIDUS

DAVID RIESMAN

	PAGE
Introduction	774
Treatment	775
References	778

CHAPTER VI

OBESITY

EDWIN A. LOCKE

Introduction	779
Physiology	781
Prophylaxis	786
Treatment	787
Choice of Cases	787
General Considerations	788
Dietetic Treatment	790
Foods Allowed	800
Foods to be Avoided or Greatly Restricted	800
Mechanical Therapy	805
Hydrotherapy	808
Medicinal Treatment	808
Treatment after Reduction	810
References	811

CHAPTER VII

RACHITIS

ISAAC A. ABT

Geographical Distribution	812
Pathogenesis	812
Etiology	814
Heredity	815
Prophylaxis	815
Treatment	816
Dietetic Treatment	816
Medicinal Treatment	817
Treatment of Florid Rickets, or the Early Cases	817
The Blood	818
Respiratory and Intestinal Disorders	818
Glandular Enlargement	818
Muscular Weakness	818
Deformities	818
Nervous Complications	819
References	820
INDEX	823

LIST OF ILLUSTRATIONS

TYPHOID FEVER

FREDERICK C. SHATTUCK

FIGURE	PAGE
1. A four-hourly chart of personal case	22

TYPHUS FEVER

ALVAH H. DOTY

1. Chart of case of typhus, with gradual decline of temperature, followed by recovery	35
2. Chart of case of typhus, with decline of temperature by crisis, followed by recovery	36

TUBERCULOSIS

HERBERT MAXON KING

1. Adaptation of roof of a city house to the requirements of an outdoor life for children	458
2. Fresh air class for anemic children, Public School 21, Mott Street	461
3. Rest hour in Public School 21	462
4 and 5. Clinic of Dr. Rollier, Leysin, Switzerland	475
6. Dr. S. A. Knopf's window tent	480
7. Dr. S. A. Knopf's "Star Nook," an outside sleeping cage adapted to city conditions	481
8. Temperature chart, showing unsatisfactory result from "comparative" rest with continuous excessive autoinoculations, followed by period of "absolute rest" and better control of autoinoculation	483
9. Temperature chart, showing modern method of controlling autoinoculation by absolute rest	484
10. Instruments and apparatus required for tuberculin administration	513
11. Logarithmic table of progressive dosage devised by Brown and Pope	521
12. Artificially induced and controlled autoinoculation by means of graduated labor. (Men patients at Annex of Loomis Sanatorium)	532
13. Artificially induced and controlled autoinoculation by means of graduated labor. (Men patients at Annex of Loomis Sanatorium)	532

FIGURE		PAGE
14.	Artificially induced and controlled autoinoculation by means of graduated labor. (Men patients at Brompton Hospital Sanatorium, Frimley, England)	533
15.	Artificially induced and controlled autoinoculation by means of graduated labor. (Women patients at Brompton Hospital Sanatorium, Frimley, England)	533
16.	Artificially induced and controlled autoinoculation by means of graduated labor. (Women patients at the Annex of Loomis Sanatorium)	534
17.	Doctor Samuel Robinson's apparatus for the production of artificial pneumothorax	536

DIABETES MELLITUS

DAVID RIESMAN

1.	Scheme illustrating the relation of the liver and pancreas to the ductless glands and the nervous system, with reference to carbohydrate metabolism	721
2.	Diagram illustrating normal sugar metabolism	723
3.	Diagram illustrating the theory of non-utilization of sugar in diabetes	723
4.	Diagram illustrating excessive formation of sugar through non-retention of glycogen in the liver	724
5.	Illustrating the quantitative relations and the caloric values of the normal and of various diabetic diets	737

THERAPEUSIS OF INTERNAL DISEASES

VOLUME II

I. INFECTIOUS DISEASES

CHAPTER I

TYPHOID FEVER¹

FREDERICK C. SHATTUCK

PROPHYLAXIS

So much do we know of the causative agent of typhoid fever, of the means by which the disease is spread, and of the way in which such spread may be prevented, that it is quite conceivable that, within a reasonable time, the disease should, in the human, not in the geologic, sense, be exterminated from the earth—that the *Bacillus typhosus* should become as extinct as the great auk. A consummation so devoutly to be wished is, however, easier to conceive than to realize in fact. By far the larger part of the inhabited earth is occupied by people who must long remain backward from a sanitary point of view. The ease and rapidity of intercommunication between the uttermost parts of the earth are constantly growing. Among the most enlightened peoples the by-product of those whose minds seem to be as impenetrable to the evidence of science and to common sense as is lead to the X-ray—cranks, in short—seems to be fostered rather than eliminated by civilization. The prevention of smallpox is a simple problem as compared with that of typhoid fever, and is more than a century old; but ignorance and prejudice still live, even among the most advanced peoples, and the time when vaccination for smallpox shall become a lost art is not in sight.

Vehicles of Transmission.—The means of general prevention lie, broad-

¹ See also 1, Vol. I, Sec. I, Chapter III.

ly, in such care of every patient with the disease that he cannot be a menace to others. While we probably know how to do this the practical difficulties in the way are such that it behooves us, for the present at least, to safeguard especially the vehicles of transmission, among which the chief are water and milk. Proof of this statement, in conjunction with our own experience, seems to be afforded by the fact that among the Chinese in China typhoid is a very rare disease, though common enough among Europeans in that country. In that over-populated country, where the struggle for existence is so fierce, human excrement is largely used for manure in a retail way, and there is thus ample opportunity for infection from dirty hands. The Chinaman¹ is not immune to typhoid, but at home he never drinks raw milk or unboiled water, that is to say, he looks after the seed and disregards the soil. There being no seed, he does not need to consider the unfastidious fly as a means of transmission. Probably the quickest and simplest way for us to stamp out typhoid would be the universal adoption of the Chinese custom as regards water and milk; but, as things are, we must regard seed and soil alike. In a country as extensive as the United States, here densely, there sparsely, inhabited, with large areas so remote from hospitals and laboratories that the physicians serving them are practically cut off from the all-important diagnostic evidence of the early blood culture on bouillon or bile, and the Widal reaction, the practical difficulties are very great. The protean aspects of the disease and the diagnostic difficulties arising therefrom are notorious. Granting that no guilty man brought to trial escapes, we know that some are neither accused, nor even suspected. We have all seen patients clearly in relapse who had consulted no physician in the primary attack. How many people have typhoid without knowing it? Any one of these may become a typhoid carrier and an innocent source of many other cases, even if every case of typhoid coming under observation is promptly recognized and properly treated. Physicians remote from centers of population may have no outside facilities for determining whether a patient after recovery becomes a carrier or not. They cannot, at present at least, be expected to have both the knowledge and equipment necessary to settle the questions themselves. No typhoid patient is discharged from the Massachusetts General, and doubtless the same rule holds with most similar hospitals, unless cultures of the urine and stools are negative. The difficulties inherent in the application of such a rule

¹Since the above was written the writer has had the benefit of meeting Dr. Edward Hume of the Yale College Hospital in China at Changsha in the Province of Hunan. It seems probable that typhoid among the Chinese in China is not as rare as has been supposed. Were it not, however, for their abstention from raw milk and unboiled water typhoid would be enormously rife among a people most primitive as regards sanitary science and more than almost any other coming into intimate contact with the usual vehicles for the transmission of the disease.

in private practice, especially among those of moderate or slender means, are patent, though not insuperable, provided there be real coöperation of the profession, active boards of health properly furnished with both money and power, and the public. Too many health boards are such only in name, naked, impotent, or both. Heavy penalties for failure to report cases promptly may help the cause, but more reliance is to be placed on the enlightened conscience and mind of the physician than on his fear of punishment. The penalty can be enforced only through the courts. I recall a case in which the apparently wilful neglect of a physician to report a case to the local board of health was shielded by the partiality and friendship of the judge. It is not worth while to enumerate all the factors which work against the eradication of typhoid fever from the earth. Many and various as they are, our ideal is clear, the means for its attainment are understood and are gradually gaining acceptance, and the fact remains that typhoid fever is becoming less frequent. It is still far more common in this country than it ought to be. In all matters of this character we, with our forty odd sovereign states, are at a disadvantage, temporarily it is to be hoped, with autobureaucratic Europe and compact Great Britain.

Some outbreaks of typhoid, naturally rather limited in extent, have been traced to raw oysters taken from beds contaminated by sewage. Oysters do not contract the disease themselves, but pass on viable bacilli. For a time after one of these outbreaks it has been interesting, if not amusing, to watch the attitude of guests at dinner parties with regard to raw oysters. Even when an outbreak was far removed and the source of the oysters served was presumably above suspicion, at least half of the guests would leave their oysters untouched. The sale of grapefruit and other substitutes was probably materially helped at these times. Some people forego oysters altogether on this account. The vast majority of cases depend upon either water or milk. Against the dangers of these consumed away from home different people will take different degrees of precaution, abstention or thorough boiling being the only absolute means of prevention.

While it is true that a small number of typhoid bacilli withstand prolonged freezing, it seems to be established that the risk of the spread of the disease through ice is not sufficient to warrant unusual precautions.

Vaccination.—A further means of general prophylaxis is antityphoid vaccination. It is not impossible that this in time may be as generally enforced as is vaccination for smallpox. Till now it has been employed on a large scale only in troops. Military organization and control permit procedures which are difficult in civil life. The history of antityphoid vaccination, interesting as it is, is too long to give here. It is well set forth in Major Russell's Wesley M. Carpenter Lecture (9), as are all other details of the practice. It is about fifteen years since Pfeiffer and later Wright began the work. At first it was, of course, tentative. The best

method of preparing the vaccine, of preserving it, its dosage, the best technique of administration, all had to be worked out. It is not to be wondered at that the first results were inconclusive; but we see a steady growth to the perfection attained in our army in Texas. This is so remarkable that I borrow freely from the report of Dr. Kean (3), U. S. A., acknowledging my indebtedness both to him and to Major-General Wood for advance information.

"The immense advance in camp sanitation and particularly the value of this protective measure can be estimated by comparing the typhoid incidence of this camp with that of the Second Division, 7th Army Corps, which was organized at Jacksonville, Florida, about June 1, 1898, and remained there in camp until October, some of the regiments leaving in September. This Division was not conspicuously unfortunate in its typhoid record for that time, and is selected because of the close similarity of its conditions of service to those of the Maneuver Division. The two divisions were encamped in nearly the same latitude and for about the same length of time, and each had a good camp site and an artesian water supply of unimpeachable purity. While the period in camp of the 2d Division, 7th Army Corps, was later in the year, the number of men involved is larger for the Maneuver Division. The following table, referring to the former, is taken from the celebrated 'Report on Typhoid Fever in U. S. Military Camps in the Spanish War' by Reed, Vaughan, and Shakespeare, Vol. I, page 609:

1898

Table showing for the regiments of the Second Division of the Seventh Army Corps assembled at Jacksonville, Fla., the mortality and morbidity from typhoid fever.

Regiments	Mean Strength	Cases of typhoid fever		Deaths from typhoid fever	Deaths from all diseases
		Certain	Certain and probable		
2d Illinois.....	1,095	253	341	18	22
1st North Carolina.....	1,164	147	227	16	20
2d New Jersey.....	1,153	185	318	29	32
1st Wisconsin.....	1,232	209	311	46	48
50th Iowa.....	1,097	164	253	33	33
9th Illinois.....	1,288	153	248	18	28
2d Virginia.....	1,220	105	152	17	20
4th Virginia.....	1,274	135	231	21	28
49th Iowa.....	1,236	378	612	50	50
Total.....	10,759	1,729	2,693	248	281

1911

Table showing for the organizations composing the Maneuver Division at San Antonio, Texas, the morbidity and mortality from typhoid fever, March 10 to July 10, 1911

Organization	Mean Strength June	Cases of typhoid fever	Deaths from typhoid fever	Deaths from all diseases
11th Infantry.....	924	....	....	..
15th Infantry.....	969	....	....	2
18th Infantry.....	1,022	....	....	..
13th Infantry.....	929	....	....	..
22nd Infantry.....	1,033	....	....	..
10th Infantry.....	1,016	....	....	1
17th Infantry.....	953	....	....	..
28th Infantry.....	950	....	....	..
3rd Field Art.....	847	....	....	2
4th Field Art.....	741	....	....	1
Engineer Bat'n.....	536	....	....	1
Signal Corps.....	197	....	....	..
9th Cavalry.....	743	....	....	..
11th Cavalry.....	1,143	....	....	3
Sanitary Troops.....	606	1*	....	1
Total.....	12,659	1	0	11

NOTE—In addition to the above a civilian teamster, not immunized, was admitted for typhoid fever in April. (*) This case, a private of the Hospital Corps, had not completed his immunization, having taken only two doses. The case was very mild and would perhaps have been overlooked but for the rule that blood cultures were made in all cases of fever of over 48 hours duration. The Widal reaction has no diagnostic value in immunized persons, as all respond to it. Forty-nine cases of typhoid fever with 19 deaths were reported as occurring in the city of San Antonio during this period."

The bulletin issued December 15th, 1911, by the Connecticut State Board of Health reports the results of the use of antityphoid inoculation during the recent epidemic in Torrington, Conn. Among four hundred citizens voluntarily inoculated, only one very mild case of the disease occurred. Of forty-five nurses inoculated, none had typhoid. Of thirty-five who refused, two got the disease in a very severe form.

Those coming into close contact with typhoid cases or liable to do so should be vaccinated. The value of vaccination among those directly exposed to the disease in the capacity of physician, nurse, or attendant is well shown by Spooner's (10) experience at the Massachusetts General Hospital. Since July, 1909, 200 individuals have been vaccinated, and no case has developed among them since the practice was enforced. During the ten years previous to 1909 there were contracted within this hospital, apparently from direct or indirect contact, 27 cases of typhoid fever, or 1.6 per cent. of all those exposed to the disease. In all, about

700 people exposed to the disease in various hospitals have been inoculated. Among these 3, or 0.43 per cent., have contracted the disease; 2 of these cases were inoculated during an epidemic and were in the incubation period; the third case was also in the incubation period when inoculated. In all 3 cases, however, the course of the disease was comparatively mild.

Those about to travel, or for any other reason liable to exposure, should also be vaccinated. The pleasure of many a European journey has been more or less poisoned by the real or fancied necessity for taking precautions, sometimes so minute and far-fetched as to be ridiculous. Danger, in the minds of some, has lurked round every corner. It is, moreover, not possible to guard against every contingency. It is doubtless a safeguard to drink only bottled water when traveling, yet there is no absolute guarantee against human cupidity, and there are those who have yielded to the temptation of the enormous profit to be derived from some form of water substitution.

Some reports suggest that antityphoid vaccination of a typhoid carrier may cause the disappearance of the bacilli from the gall-bladder and elsewhere, in part, for a time, or even permanently. Moffitt has collected eight cases of typhoid carriers reported thus cured. If such a result is confirmed by experience, its far-reaching consequences are obvious.

Although the results obtained by antityphoid vaccination have been most encouraging, it has been the belief that there is one serious drawback, to wit, that it is unsafe to vaccinate individuals exposed during an epidemic because of the increased susceptibility during the "negative phase" following an inoculation. That this objection is not justified by facts is the opinion of no less an authority than Major Russell, who states that it is very doubtful if there is any increase of susceptibility following inoculation.

The technique of administering antityphoid vaccine is simple, and as practiced in the U. S. Army is as follows: The site of puncture, usually the outside of the left arm, is sponged off with alcohol, and a small area sterilized with tincture of iodine. The injection is made subcutaneously with a sterile syringe and the puncture sealed with collodion. The first dose is 500,000,000 bacilli, the second and third 1,000,000,000 each. An interval of ten days is allowed between doses, the entire procedure thus taking twenty days. The method used at the Massachusetts General Hospital is essentially the same, but the size of the dose and the interval between doses differ. Four doses are given at intervals of five days. The first dose 50,000,000; the second 100,000,000; the third 200,000,000; and the fourth 400,000,000 bacilli. This dosage is considerably smaller than that used in the army, but the vaccines differ in that in the preparation of the army vaccine the culture is killed at 60° C., while the culture used at the Massachusetts General Hospital

is killed at 53° C. It has been definitely proven that the vaccine killed at the lower temperature is the stronger.

For the precautions taken in the Texas camp against flies as factors in spreading the disease, the reader is referred to Dr. Kean's report. In civil practice comparatively little can be done to diminish the number of flies. It is desirable to do what one can, as by screening, to prevent their having access to typhoid patients or their excreta. It is more practicable to prevent the access of flies to excreta than to exterminate flies. A fly which neither contains nor carries typhoid bacilli is not dangerous.

Sera.—A variety of sera have been used but without results sufficiently encouraging to warrant continuance of the practice. Dr. Mark W. Richardson tried various modifications of the serum treatment in the Massachusetts Hospital for some years, largely on patients in my wards. I could not convince myself that the patients were benefited, and some of them distinctly suffered in comfort.

Prevention of Extension.—The principles underlying the prevention of the extension of the disease from the individual patient to healthy people are clear and fixed. Their application to the special case must vary in detail with the circumstances under which said case is cared for.

The chief danger lies in the feces and urine, their accessibility to flies, and in the bed and body linen liable to be soiled; but all secretions and excretions are possible sources of danger. With proper precautions isolation of patients is not necessary, and no valid objection can be raised to their care in the general medical wards of a hospital. It is well, for convenience, to group the typhoid cases under a special nurse or nurses.

Although Boston, as a seaport town, discharges its sewage into salt water and only on the first half of the ebb tide, the following rules are observed in the Massachusetts General Hospital, and are in essence those which should obtain in any large institution:

Feces.—The bed-pan is emptied and washed out into a special hopper (11), the outlet of which has been previously closed. The cover is shut down and steam allowed to circulate in a jacket at the bottom of the hopper. The contents are thus quickly brought to the boiling point and there maintained for five minutes.

Bed-pans and urinals are sterilized by boiling for five minutes in a hopper devoted to them.

Bath water is also boiled for five minutes.

Sputum cups, compresses, and mouth swabs are put into paper bags, marked "typhoid," and burned in the boiler house furnace.

Bed and body linen are put into a special bag, marked "typhoid," and boiled in the laundry separate from other linen.

The *mattress* is sprinkled with a two per cent. solution of formalin, marked "typhoid," also with date and ward, and sent to the fumigating room, where it is exposed to formaldehyde gas for twenty-four hours.

Each mattress receives at least two fumigations, sometimes more, according to the demand.

Rubber sheet, rubber pillow case, bedstead, and stand are washed with soap and water and then with a 1 to 3,000 solution of corrosive sublimate.

Special *thermometers* are used for typhoid patients. After use they are washed with soap and water and kept in a 1 to 1,000 solution of corrosive sublimate.

Special *enema syringes* and *rectal tubes* for typhoid patients are washed in cold water, then in hot water, boiled three minutes, and kept in salt solution.

Special *dishes, cups, etc.*, for typhoid patients are washed separate from other dishes in a special dish pan, placed in a dish sterilizer, and boiled for ten minutes.

Nurses wear *aprons* with long sleeves when making the bed, feeding, and bathing the patient. *Rubber gloves* are worn when the bed-pan is handled and when the mouth is swabbed.

The *clothes* worn by the patient on entrance are exposed to formaldehyde gas for twenty-four hours.

Of course, such measures as are above detailed can be carried out only in large institutions. Equally good results can, however, be obtained anywhere by the intelligent adaptation of means to ends. The Massachusetts State Board of Health (8) officially recommends the following treatment of stools and urine:

"Milk of lime (one part freshly slaked lime to eight parts of water), or chlorinated lime (6 per cent.), or carbolic acid (5 per cent.), or formalin (10 per cent.), or boiling in soda solution. The discharges should be received in a vessel containing some of the germicidal solution, and more should be added so as to cover the mass and be equal to at least twice the volume of the material to be disinfected. The entire contents of the vessel should then be thoroughly stirred, special care being taken to disintegrate lumps. The vessel should be covered and allowed to stand not less than one hour before the contents are discarded."

Compresses and all small articles contaminated, or specially liable to become so, should be burned.

Privies should be screened, water-tight, and cleaned only under official supervision.

Bed and body linen should be soaked in 5 per cent. carbolic solution for several hours, boiled, or both. Bath water should be boiled.

When the surroundings permit, the stools and urine can be buried after disinfection, of course with due regard to wells or other water supply.

If the family is engaged in the milk or any other business connected with foodstuffs obvious special precautions are in order, and it may be necessary, in the interest of public health, to suspend such business until all danger of contamination is past. Four negative and consecutive

examinations of the stools and urine should be required of persons thus employed before they are allowed to resume ordinary work.

Carriers.—A chronic carrier should be kept under the supervision of the local board of health and not allowed to handle foodstuffs for others. If he moves to another place, the local health authorities of that place should be notified, if possible. It is, of course, obvious that such a person may start an epidemic running into the hundreds of cases. In this connection it is of interest to note the statement that, on December 3d, 1911, Mary Wallon, otherwise known as "typhoid Mary," entered suit against the city of New York for alleged false imprisonment by the Board of Health.

TREATMENT

General Care.—In any case in which typhoid fever is suspected—and it should be suspected in every continued fever until proved absent—the patient should be put to bed and treated provisionally as if he had typhoid. Even if the disease be mild, each case is a potential source of disease to others. In a case which is mild at first gravity may appear later, either from severe toxemia or one or more of the many accidents and complications incident to the disease. It is, therefore, of moment to save the strength from the start. We have all seen cases in which, from avoidable or unavoidable delay in diagnosis, patients have dragged themselves about and become so exhausted that this very exhaustion seemed a leading feature of their disease, perhaps the determinant one as to recovery. The slow development and long duration of typhoid afford a sharp contrast between it and some other acute infections, pneumonia, for instance, a point worthy of therapeutic consideration.

Should proper care be difficult or impossible at home, entrance to a hospital, if such be accessible, is to be urged. It is of the last importance to provide for proper nursing. If possible, there should be two nurses. If the eight-hour limit is adopted, either through unions or by law, at least three will be required. In severe cases three are none too many, some items of care—bathing, for instance—being difficult to carry out by a single nurse. Of course financial and other considerations only too often make the ideal unattainable. We must content ourselves with coming as near it as we can. The best room in the house, if possible with a sunny exposure, windows on at least two sides, an open fireplace, and convenient bathroom, is to be devoted to the patient. As in other infectious diseases, or, indeed, for that matter, in disease in general, the fewer unnecessary articles in the room the better. Of course carpets, curtains, and the thousand and one things with which the rooms of the well-to-do are nowadays encumbered are less objectionable in typhoid than in the eruptive infections; but they greatly and needlessly add to

the burden of care of the room and interfere with the quiet so desirable about the sick.

Among the requirements of the sick room I give the open fire a high place. It warms rather than heats the room, and, above all, promotes ventilation. I do not think that the advantages of a combination of open fire and open window are as widely appreciated as they should be. Hard, thoroughly dry, non-snapping wood with a plentiful bed of ashes yields the best results to those who know how to secure them. It is easy to change, almost in a moment, from a brisk to as slow a fire as you please, or *vice versa*. Soft coal comes next. Anthracite is a bad third. The gas fire has its convenience. Direct radiation as a means of warming rooms is cheap and nasty.

Compresses and small articles are readily burned in the open fire, if such there be. It is to be remembered that the disease may be carried from one patient to another or to a healthy person by an enema syringe or a thermometer. The risk of transmission through spoons and other feeding vessels is very slight with ordinary care.

The use of the bed-pan is to be rigidly enforced, as a rule. Few people take kindly to the bed-pan at first; but the habit is generally soon acquired, and a little water thrown into the rectum helps much to overcome the disadvantage and novelty of the supine position. Now and then, however, we have to deal with a patient who does not seem able to reconcile himself to the bed-pan. Its use involves more fatigue than does that of the cabinet at the bedside with proper assistance. If the net result of the bed-pan is squandering strength, a means less open to that objection is to be preferred. Common sense should rule here, as elsewhere. The minimum output of strength is the underlying principle of the bed-pan. It is not likely that the sitting posture in itself can cause hemorrhage or perforation, and the chance that unjust blame may be attached to the attendant for a really unpreventable accident should not be paramount to the interests of the patient. The notions of the laity about matters medical have nearly always been derived from the profession; but are apt to be more or less out of date. The head of the procession precedes the tail. This seems all very trite, but is not so much so as it seems. We are all of us prone to follow rules—the line of least resistance. This is as good a place as any to insist on the application of active common sense to the principles of management of a person sick with a disease which we do not as yet know how to cure.

The danger of leaving a typhoid patient alone, even for a moment and even when not seemingly delirious, must be mentioned and realized. A chance to jump out of the window, to conceal or use a razor, scissors, or the like, may be cunningly watched for and promptly seized by a mind which appears saner than it is.

The mouth, teeth, and tongue are to be carefully cleansed with a cot-

ton swab and boric acid, or other similar solution, at least three times a day, and a little glycerin may be used on the lips. Sordes, and a dry, leathery tongue, like that of a parrot, are mute accusations of the doctor and nurse, as a rule. For many years all my typhoid patients have had their throats sprayed thrice daily with Dobell's solution, and I am confident that middle-ear inflammation has been decidedly less frequent under this routine.

It has been said that the best treatment for bed sores is to discharge the head nurse. Certain it is that, under proper care of the nates and parts specially exposed to soil and pressure, bed sores are rare. Cleanliness and dryness are potent preventives. So also is change of position, and thus of the seat of pressure. The least sign of redness should lead to extra vigilance and the use of pure alcohol frequently over threatened areas. The air or the water bed, if available, may be a help. Rings can be made, in sizes to suit, of toweling or tow, and covered with cotton bandaging over a layer of sheet cotton batting. They have an advantage over rubber rings in that they are more absorbent.

Visitors should be excluded and interviews with members of the family brief. The mere presence of a judicious member of the family in the room, to spare the nurse or for other reason, may be not only admissible, but desirable. Only in the mildest cases should the patient be allowed to read. Reading aloud may be soothing, help to pass the time, and serve to divert the thoughts from business or other undesirable channels.

The covering of the patient should not include a bed-spread, especially if starched. Bed-spreads may gratify the eye of the careful housekeeper, but serve no really utilitarian purpose. If the size of the sick room and circumstances permit, two beds are better than one, each to be occupied twelve hours. The patient can easily be rolled from one to the other, gets refreshment from the change, and the mattress retains its shape better. Beds in private houses are apt to be too low for nurses to do their best work. A low, double bed and a heavy patient make a difficult combination.

Diet.—Typhoid fever is an acute infection varying in duration from three weeks to three months, if there are repeated relapses. After severe cases, or in those past the prime of life, in whom repair is relatively slow, convalescence is apt to be tedious. The most frequent cause of death is asthenia, the heart giving out owing to the action of toxins on the myocardium and on the central nervous system. Supportive treatment and the maintenance of the strength are, therefore, matters of great moment, far more so than in an infection of short course, like pneumonia. In tuberculosis, usually a chronic infection, we strive to increase the digestive limit and to feed the patient thereto. Although typhoid is a self-limited disease to a degree and in a sense that tuberculosis is not, I believe that the same principles as to diet should obtain in both diseases, were it

not for one—and a vital—difference, to wit, the constant intestinal lesions of typhoid. There is no parallelism between the symptoms and the number, extent, or depth of the intestinal ulcerations. Loss of blood from an ulcer may at any time convert a mild into a very serious case, perhaps kill the patient directly, more often seriously add to the asthenia. Perforative peritonitis, general or local, the gravest accident in typhoid, is liable to occur even in the earliest part of convalescence. We have, therefore, to strike a balance between the needs of the body as a whole and the special care demanded by the ulceration and its seat. To limit the extent and promote the healing of ulceration which we can see, we do not set our ingenuity to work to devise an approach to the constant unrest of peristalsis, nor do we use fecal matter as a dressing. It is true that cow dung has been used for making poultices and may possibly be still so used in some bucolic districts. But its use for the purpose is not making headway, to say the least, and I do not know that it was applied to raw surfaces. As a matter of fact, typhoid intestinal ulcerations do heal perfectly in the great majority of cases, perforation and hemorrhage combined being responsible for probably not more than 1/10 per cent. of the general mortality of 8 or 10 per cent. It seems, however, rational to suppose that a dignified and gentle peristalsis, and, as far as may be secured, unirritating intestinal contents, tend to reduce to a minimum the risks of these accidents which are still bound to occur sometimes, in spite of what we can do or refrain from doing.

I was taught that milk should be the main or exclusive article of diet in typhoid fever, and for two weeks after the temperature had struck normal. This teaching I followed for some years after I came into the charge of hospital wards. At first, during the typhoid season, I hardened my heart against the prayers, even against the tears, of patients clamorous for articles of food which I now believe to be innocent. Two or three cases of continued fever, as the cause of which I thought myself justified in excluding typhoid, were fed on extra diet—whatever they wanted and the hospital could afford. They recovered safely, quickly enough, and comfortably. Subsequent review of these cases convinced me that I had been at first mistaken in diagnosis, that they had really gone through typhoid fever and had come out of it in better condition than was common in the Massachusetts General Hospital in those days. This set me thinking—very hard work for me—and led me to formulate a principle, adherence to which for twenty years has never caused me regret; on the contrary, only satisfaction. This principle is that every patient with typhoid fever should be fed with reference to his digestive power, with exclusion of such articles as in themselves or in their residue may be irritating to the raw surface in the gut or may produce undue peristalsis.

We have not escaped entirely from the old doctrine of inflammation and its starvation. We are inclined to fear the local manifestations more than the general disease, to treat the disease rather than the patient, sometimes to forget that a routine is our servant, not our master.

Those patients whose irritable stomachs led to the use of the term "gastric fever" must be fed with the greatest care on bland liquids, perhaps in very small quantities and at very frequent intervals. In my experience such gastric irrita-

bility is usually a relatively early and transitory symptom. Other patients seem ready to take and digest anything that we give them, even during pronounced fever. Between the two we see every possible gradation, as well as wide differences between the digestive power of the same patient at different periods in the disease. Food should be given every two or three hours. The interval should seldom be longer than three hours during the day, but may be exceeded during the night rather than wake the patient from a relatively natural sleep. Toxic stupor is not a valid cause for a longer interval. I still give milk, more or less, or none, according to the condition of the patient at the time. Since we have been encouraged to think in calories, we are told that a larger amount of milk is needed to maintain the body weight than can practically be given to a sick person. Even if this be true, a moderate loss of weight does no harm and is rapidly made good during the leisure of convalescence. Moreover, whether from ignorance, prejudice, or both, I confess to some skepticism as to the methodical application of caloric values to a living organism, as if it were a machine made in Germany. The living body has a surprising power of adaptability. We see individuals, as well as races, developing more energy than the caloric value of their food would seem to warrant. We must always remember that the living body is a variable and that the result of its multiplication by a fixed factor, assuming the caloric value to be fixed, is liable to be a variable. But we cannot safely assume the caloric value of daily life to be a fixed factor. All oatmeals are not the same, and in like manner there is a variation, which may be important, in every other article entering into the dietary of man. And, moreover, how about the cook? One cook surely differeth from another in glory, and those who are capable of large destruction of whatever caloric value a raw material of diet may contain are, unhappily, the rule rather than the exception.

Alexander Lambert now forbids milk altogether to his typhoid patients, and notices a greatly lessened frequency of meteorism since his interdiction. On the liberal and mixed diet which I use meteorism is rare save in severe cases, and then seems attributable far more to toxic paralysis of the gut than to dietary influence.

Warren Coleman has made careful studies of the application of caloric values to the feeding of typhoid patients, and finds that by the addition of cream and of sugar of milk to milk he can prevent body waste. A patient weighing 150 lbs. should be given the food equivalent of 4,000 calories a day. His daily diet is something as follows:

1½ quarts of milk.
1 to 2 pints of cream, 25 to 30% fat.
½ to 1 ⅔ pounds of milk sugar.
3 to 6 eggs.
Stale bread or toast with butter.

This study is of interest, and may be of importance in cases presenting unusual difficulties for proper nutrition; but it seems to me in the great majority of cases caloric values can be disregarded. If the patient is comfortable, progressing favorably, without indication of digestive disturbance, and is fed up or nearly up to his digestive limit, it does not make any difference how many calories the food contains.

The arguments in favor of the dietetic principle above stated are enhanced comfort to the patient and a shorter convalescence. Incidentally, loss of hair as a sequel of the disease, I suppose an index of markedly lowered nutrition, practically has not occurred since I abandoned exclusive milk diet, though it was not

uncommon before. I have been accused of giving pork and beans to my typhoid cases, partly, doubtless, but not wholly, in fun. The following list of admissible articles and preparations claims to be suggestive rather than exhaustive:

All liquids, including broths and cocoa.
Soups—purée of oysters, clams, potato, etc., etc., carefully strained.
Gruels, strained if containing rough particles.
Ice cream, blanc-mange, junket, milk toast without crust, sherbet.
Eggs, raw, soft boiled, lightly scrambled.
Meat, finely minced, scraped raw beef.
The soft part of raw oysters, macaroni, rice.
Orange and grape fruit juice.
The soft part of baked or stewed apples.

The best results will be obtained only by the physician who applies sound principles to the management of his case, allows no change in conditions to escape him, and is ever ready to modify details as the idiosyncrasies of the patient or the varying features of the individual patient demand. Water should be given freely, if for no other reason with the hope of causing large renal output and thus elimination of toxins soluble therein. I have seldom given water in the quantities advocated and administered by the late Dr. E. W. Cushing, of Cleveland, one to two gallons a day. This has been aptly termed "a species of internal hydrotherapy."

I am inclined to believe it possible to enhance the danger of cardiac dilatation through the extra demand made upon a weak heart in taking care of large amounts of fluid. If for any reason water enough cannot be given by the stomach, it should be given by the rectum, i. e., normal saline solution either in bulk or by seepage, as may seem wise. If the rectum be rebellious, it may be desirable to employ hypodermoclysis. Glucose 10%, lactose 6 to 8% can, if it seems desirable, be added to the water, introduced either into the rectum or under the skin.

It is held by some that alcohol is always and everywhere noxious; but it is generally admitted that it is a food, and as such is touched upon here. It is not only capable of directly producing energy, but also, probably in some way not fully understood, guards the tissues against waste, especially when a severe infection has taken possession of the body. Many, perhaps the majority, of cases, require no alcohol from start to finish. If the pulse is good and assimilation and secretion satisfactory, there is possibly even less reason for giving alcohol than to a person in full health; but if the heart shows distinct signs of undue weakness, if hypostasis is threatening or marked, if the power to take, retain, or appropriate nourishment is unduly lowered, I believe it to be a grave error in judgment to withhold alcohol. It can be given as absolute alcohol diluted with water, nearly tasteless, or in the form of liquor, wine or beer, as may seem or prove to be wise. Whatever form of alcohol be chosen, it is better to give it pure or with water alone, and not mix it with articles more commonly classed as food. The danger of forming an alcoholic habit is practically *nil* in the subjects of acute general infection. They are more likely to acquire a distaste than a liking for it. The presence of the smell of alcohol on the breath may be deemed evidence that the dose already given has not been used up, and thus an indication to wait and perhaps to reduce the next dose. An intelligent and reliable nurse can be of great service in helping to decide when and how much alcohol to give. Three or four ounces of whiskey or its equivalent rarely needs to be exceeded during twenty-four hours; but cases now and then are met with in which it should be given, usually

to tide over an emergency, up to the limit of toleration. It can, of course, be added to enemata, or even put into a glucose-salt-solution and introduced under the skin in the strength of an ounce to the pint.

If the patient has been liberally fed during the fever no great change is in order for convalescence. I do not nowadays often see the ravenous appetite or the rapid digestion, leading one to compare the stomach to a dredge at work, so common during the restricted diet period. It is to be remembered that the subsidence of fever does not mark the healing of the ulcers, which may be delayed several weeks. As before stated, we have no means of even guessing how deep and extensive or numerous these may be. Those of us who are past middle life recall how generally relapse was attributed to a dietary error, and the cross-examination of the nurse or patient which was held to find out whether a friend, soft alike in heart and head, had brought forbidden fruit.

We now know that true relapse, a fresh infection from failure to secure immunity, cannot be so produced. An error in diet may cause hemorrhage or perforation; it may result in transient elevation of the temperature for a few days perhaps. That it can start up a relapse is not credible. It may be stated that fever recrudesces; typhoid fever relapses. It may be well for the physician who feeds his typhoid cases more liberally than his neighbors to explain this matter to the family at the outset, and thus to forestall criticism.

The following table shows the comparative mortality in the Massachusetts General Hospital, by five-year periods, from 1892 to 1910, inclusive. Under the Shattuck diet come only those cases which were under my personal care, although of late years my colleagues have been gradually adopting a liberal diet, which is now in force throughout the hospital. My number of cases is relatively small from the fact that for many years my service was during the winter and thus did not include the typhoid season. It will be observed that my mortality is practically two per cent. less than that of those classed as fed on liquids. It seems to me that my figures are large enough to show conclusively that the liberal diet does no harm. Anybody who has followed its application cannot fail to be struck by the enhanced comfort of the patient and the shortening of convalescence:

Year	No. Cases on Shattuck Diet	Deaths	Mortality Per Cent.	All Other Cases at M. G. H.	Deaths	Mortality Per Cent.
1892 to 1896.....	134	17	12.6	336	50	14.8
1897 to 1901.....	100	8	8.0	707	80	11.3
1902 to 1906.....	97	10	10.3	807	80	9.9
1907 to 1910.....	160	10	6.2	310	28	9.0
	491	45	9.1	2,160	238	11.0

The following table was compiled by Kinnicutt (4). It will be noticed that his figures give one per cent. less mortality in favor of the liberal diet:

	Cases	Re-lapse	%	Hemor-rhage	%	Per-foration	%	Mor-tality	%
Total.....	733	48	11.38	LIBERAL DIET		10	1.36	60	9.47
				35	4.77				
Total.....	4,654	507	10.89	FLUID DIET		111	2.40	491	10.55
				411	8.83				

Hydrotherapy.—In modern times Currie, 1787, was the first to employ and advocate cold water externally in typhoid fever and in other general infections. Nathan Smith began to employ it in 1798 in this country, but did not publish his cases. It was a bold thing to do at that time, and the voice of Currie was as that “of one crying in the wilderness.” The practice ran too counter to the notions and prejudices of the times. It was revived in 1861 by Brand of Stettin, whose experience was so large and results so good as to compel attention. His following was at first larger in Germany than elsewhere, and, a curious fact, earlier on a large scale in Australia (Hare of Brisbane) than in England. France, after the Franco-Prussian War, was not prejudiced in favor of things Germanic. The English are conservative; and the expense involved in the large increase in attendance demanded by tubbing counteracted, in this country of high wages, our readiness to try any and every new method of treatment, sometimes, alas! even if not well based or reasonable.

It seems a fair statement that Brand’s method, with or without modification, was helped in its adoption by the opinion widely held about that time of the danger of high fever in itself. The cloudy swelling of the parenchymatous organs was laid at the door of the fever, reduction of which tended toward conservation, to use a word which is now so much in vogue. The temperature was not only an index for the use of the cold bath, but also of its efficacy. We know that fever is a concomitant of acute general infections, and some question whether, in its usual limits, it may not be a part of the means employed by the organism to fight the invading enemy. We are, therefore, loath to-day to combat fever as such, save when it takes the form of what is called hyperpyrexia in which the very temperature is dangerous, as in thermic fever and in the rare cases of infectious disease in which all balance between heat production and heat dissipation seems to be temporarily lost. The introduction of the coal-tar antipyretics was hailed with enthusiasm and joy by the thoughtless, with interest by all. Their effect in reducing temperature markedly and promptly was clear. Might they not save us the toil

and expense of the Brand method? It did not take very long to answer this question in the negative. As routine agents they were soon found to endanger the life of the patient, even those of them which are least depressant to the heart and guarded by caffeine at that. They still have a limited application in typhoid, to be mentioned later.

It cannot be too clearly borne in mind that the purpose of hydrotherapy is not primarily to reduce temperature. Its purpose is to promote deep breathing, thus aiding the respiratory and circulatory functions; to exert a beneficial influence—stimulation?—upon the central nervous system; to lessen delirium—toxemia of the cerebral cortex; to diminish restlessness and promote natural sleep; in short, bring about a more normal state of the whole organism. This is often noted after hydrotherapy even when the water has not appreciably lowered the temperature; nay, even when the temperature rises after the bath. The thermometric reading still remains the routine index for the use of the bath. The true index is, of course, the balanced estimate of the state of each patient at the moment. The experience, insight, and judgment which lead to right decision can neither be directly imparted by teaching nor set down in writing. The thermometric index is, when checked by fairly simple, if not obvious, reservations, pretty safe, especially if the nurse be competent. It is, at all events, the best single index we have at present.

I believe it a fair statement that the use of cold water as laid down by Brand is losing rather than gaining favor, at least in the United States. It is felt that equally good results are obtainable by forms of hydrotherapy which are less perturbing to the patient as well as to domestic life, and which require for their carrying out an amount of attendance more nearly at the command of the average family or hospital. In the Massachusetts General Hospital we have never adopted the Brand method in full. In the height of the season I have repeatedly known 50 per cent. of the medical cases to be of typhoid fever. Proper tubbing of any such number of cases involves no small addition to the seventeen dollars per week which it now costs to keep a patient, not counting the interest on the plant. That Brand and his followers have done yeoman service in bettering the treatment of typhoid fever cannot be disputed, even by those who are not in full communion in all details.

In essentials the Brand method is as follows: When the three-hourly rectal temperature reaches 102, a bath in a tub by the bedside is in order, the water from 65 to 70 degrees. The bath is preceded by alcohol in some form, and a sponging of the head and chest with cold water. While in the bath, constant and vigorous friction is used on the limbs and chest, not on the abdomen, and a cool compress is kept on the head. The duration of the bath is ten to twenty minutes. The patient is then dried, preferably on a blanket to be removed later, and he is given some nourishment. To some persons the procedure is very obnoxious, so much so as

not to warrant its continuance. Others find it very grateful, especially after they note that a secondary betterment follows. The shivering and cyanosis which sometimes occur are far from being as indicative of harm or danger as anyone seeing them for the first time would naturally deem them. In the Johns Hopkins Hospital canvas strips are so attached to clamps on the side of the tub that the proper degree of immersion of the patient resting upon them can be readily secured. The routine bath temperature is $102\frac{1}{2}$, and the water varies from 85 to 70 degrees, the higher figures being used for the first few baths, for the very young, for the old, or for other special reason.

The modifications of this method are many, the main underlying motive for such modification being economic. The bed can be made to serve as a fairly good tub by a large rubber sheet converted into a trough by blanket rollers under the sides and ends. Water at the desired temperature is easily introduced, and can readily be taken out with a sponge. Some bits of ice serve to maintain the water temperature, which would otherwise be raised by the warmth of the body and of the bedclothes. It is easier to rub the patient in a high bed while the bathing is going on than it is in a tub which involves stooping over; and, moreover, all lifting is saved. This plan has been long in vogue in the Massachusetts General Hospital and seems to give good results.

Liebermeister thought the cold wet pack quite as good as tubbing. The patient is wrapped in a sheet wrung out of cold or even ice-water, covered with blankets, and rubbed. The sheet should be changed every ten minutes and thrice applied. The warm pack is applied in the same way, water at a higher temperature being used. Rubbing need not be so vigorous nor change of sheet so frequent with the warm pack. This form of hydrotherapy is applicable to those who from age or other cause are not fit subjects for cold water.

The fan bath consists in promoting evaporation from a sheet covering the patient sprinkled with ice-cold water from a garden sprinkler, while the limbs and chest are rubbed as in the Brand method. Nathan Smith speaks of fanning with a sheet. Other modifications are the warm bath, either kept warm or gradually reduced in temperature by the addition of cold water or ice; and, again, simple sponging. The latter is varied in many ways as regards the temperature of the water used, the addition of alcohol up to 50 per cent. or more, and the amount of body surface exposed and sponged at a time. However askance these spongings may be looked upon by the strict followers of Brand, they have seemed to me all-sufficient in many cases.

Indeed, hydrotherapy in typhoid fever, as all therapeutic measures wherever applied, must be mother-tinctured with common sense. Unless the nurse be very experienced and reliable the first bath or two should be watched by the physician in private practice, by a house officer in hos-

pital. The form of hydrotherapy, its duration, repetition, and temperature should be suited to the individual patient at the time, with due consideration of the after-effects upon him even more than on his temperature. Those with a thick fat layer stand lower water temperatures than do the thin. Osler gives the mortality at the Royal Victoria Hospital, Montreal, for six years, 5.4 per cent.; at the Johns Hopkins, 9.1 per cent. in 1,500 cases. At the Massachusetts General Hospital, where we have never applied the Brand method in full, the mortality of 2,651 cases is a shade over ten per cent.

One fact leaps in the faces of those of us whose professional experience goes back forty years or so. The cases of which the term "typhoid" is really descriptive are far fewer than they were formerly; are, indeed, the exception; and I do not find it easy to demonstrate to my students to-day the "typhoid state," so-called. This change I believe to be due in the main to the vast improvement in nursing which has taken place since my student and early professional life, and to more rational feeding. Under the head of nursing, I should include so much hydrotherapy as thorough cleanliness demands. Whether epidemics are milder to-day than they were formerly, as has been claimed, I do not know.

Hemorrhage.—It is assumed that the nurse is alive to the importance of watching for signs of blood. If this appears my practice has been to limit peristalsis as far as may be by withholding nourishment, if the patient's condition warrants it, for a day or two; or by restriction of the diet in quantity and a change in quality to broths, milk, and water. Morphia is also to be used, preferably under the skin, at first one-quarter grain for an adult, and then one-twelfth to one-sixth every three to six hours, as may seem wise. Moderate narcotism is not objectionable. The respiration affords a better indication of the limit of tolerance than the pupils. A respiratory rate of twelve to the minute is perfectly safe. The behavior of the pulse and temperature is, of course, a far more trustworthy index of the amount of blood poured from the vessels, and of the effect of this loss, than is the amount passing the anus. Ice bags to the abdomen are almost universally advised. I do not forbid them, but very rarely have ordered them. Baths should be stopped, the utmost quietude secured, and the foot of the bed raised if the effects of blood loss are evident. In cases of moderate hemorrhage, especially if single and not too soon repeated, starvation and morphia for perhaps thirty-six to forty-eight hours suffice. It may become a nice question whether or not to use salt solution under the skin or intravenously, or to have direct transfusion done. Enemata of salt solution are provocative of peristalsis, an objection to which seepage is, however, less open. We must try to strike a balance between the danger of death from the loss of blood, which has already occurred, and from that of provoking fresh bleeding inherent in the measures calculated to obviate the first danger. Weaken-

ing of the heart action and a lowered blood mass tend toward the cessation of bleeding. If the heart stops, the bleeding is sure to stop. But the patient is then dead, and it is our aim in any and every way in our power to keep him alive.

As long as it seems to me safe to do so, I prefer to abstain from either stimulating the heart directly by alcohol, ether, camphor, or the like, or indirectly by rapid and notable increase in the blood mass, as by hypodermoclysis or transfusion. There are, it seems to me, few emergencies in practical medicine in which responsibility may be greater and judgment more difficult than in this under discussion. The busy practitioner must either devote himself very largely for the time to his one patient, or furnish a competent subordinate to be in constant attendance until the danger is over. Of course, it is the more serious cases which we have here in mind; but a patient bearing up well under a hemorrhage may quickly fall into an alarming condition if the bleeding is continued, or renewed and copious. Fortunately, these very grave cases are, as far as my experience goes, rare. I have not much faith in the usefulness of gallic acid and other local astringents. Adrenalin has been advised in typhoid hemorrhage; but, as it seems to me, on insufficient grounds. If the adrenalin is absorbed, by raising the blood pressure it would tend to increase the hemorrhage. Is it reasonable to suppose that a therapeutic dose of the agent given by the mouth can reach a point twenty feet below in proper and sufficiently concentrated form to act locally? This reasoning has prevented me from its use for this purpose.

[My experience with adrenalin in controlling hemorrhage has been very satisfactory. It should be administered hypodermically (1.0-1.5 c. c. of a 1:1,000 solution), or by hypodermoclysis, the same dose in one-half liter, or more, of a 0.9 per cent. solution of NaCl. It acts perfectly well by hypodermic introduction, but it may become necessary to apply it by hypodermoclysis when the normal saline solution is indicated.

Theoretically, it is a perfect remedy, as its elective action is upon the vessels supplied by the splanchnic nerves, which are parietic on account of the effect of the typhoid toxin upon the vasomotor centers. Adrenalin produces contraction of these blood vessels and causes the bleeding to stop. In the animal experiment the contraction becomes so great that these vessels seem empty and colorless. The objection that the rise in blood pressure caused by adrenalin may do harm has not been found valid in my experience. I have seen one case in which there were cardiac symptoms, but this condition did not seem sufficiently great to overcome the vasoconstrictor effects of the drug, as the hemorrhage did not recur. Moreover, one of the great objections to adrenalin, that its activity is too evanescent to produce lasting effects, does not exist here. In the great majority of cases, when the adrenalin acted beneficially, no second injection was necessary. When there was a recurrence of the hemorrhage, it occurred in from four to six hours after the first injection; in other words, the effects were those of any topical application of this drug.

The ice bag should be employed for the same reason. There are two

explanations for its beneficial effects. It reduces the frequency of the cardiac systoles, increases the blood pressure by stimulating an abdominal cutaneous reflex which causes contraction of the visceral blood vessels. Moreover, it has been stated that cold penetrates living tissues for some distance, and it has been suggested that an ice bag may produce a direct effect upon blood vessels some distance removed from the surface, by causing them to contract.

In the smaller hemorrhages which occur in the early stage of the disease and are a manifestation of general blood change, notably of its coagulability, calcium salts are invaluable. I prefer the lactate of calcium given in large doses—from 1.0 gm. to 4.0 gm. (gr. xv to 3i).—Editor.]

The cases in which surgical treatment is to be invoked must be very, very rare. The situation is quite different from perforation. Most cases of hemorrhage recover if let alone. Nearly all cases of perforation die if let alone. A patient with hemorrhage whose bleeding is to be stopped only by operation is pretty sure to be killed by the operation. We see patients recover from seemingly desperate conditions who could, humanly speaking, not have recovered had the shock of operation been superadded. At least five days should elapse between any evidence of blood loss and the resumption of baths and normal diet. In every case of typhoid fever in private practice, sterile, normal salt solution and the means for its introduction should be on hand in the house as soon as the diagnosis is reached.

A four-hourly chart and brief statement of a personal case is here appended, illustrating well intestinal hemorrhage, obstinate vomiting, and insomnia, and their treatment:

A young man of twenty-six passed through the primary attack of typhoid uneventfully, as also the first two weeks of an intercurrent relapse. Nausea then became troublesome, and some food was given by the bowel. November 7th, two ounces of clots at 9:30, fifteen ounces at 11:30 a. m.; patient blanched, very weak. Soon after the stomach absolutely refused food. November 8th, pulse barely perceptible. Salt solution intravenously at 9:30 a. m. with marked and immediate increase in the volume and the strength of the pulse. Vomiting and nausea controlled by morphia hypodermically. That evening brandy and shaved ice, a dram (4.0) every two hours, was retained; strychnia, gr. 1/30 (.002), was given every two hours hypodermically; nutrient enemata every six hours. November 10th, pulse 160, fair quality, condition very weak, extremely restless, sleepless, exhausted, delirious at times, involuntary stools. A hypodermic of 1/200th gr. (.0003) hyoscin hydrobromate was followed by peaceful and prompt sleep, after which recovery was uneventful.

TYPHOID FEVER

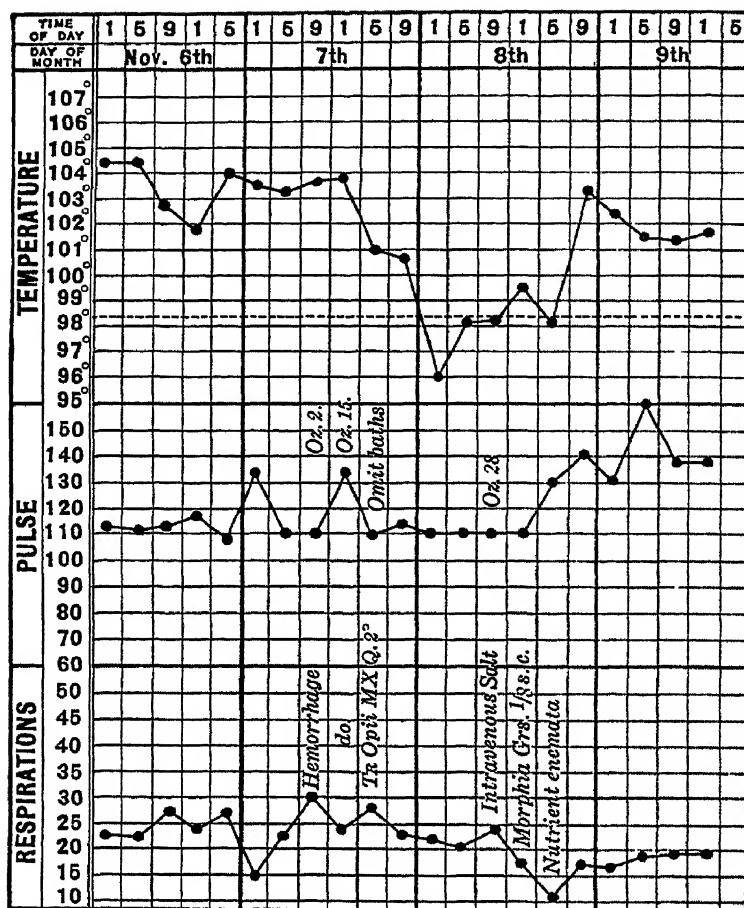


FIG. 1.

Perforation.—It is to be remembered that in a toxic patient the usual signs of perforation may be more or less blurred or even absent. It is of the last importance that the nurse be conversant with the symptoms and signs suggestive of perforation, constantly on the watch for their advent, and prompt in notifying the attendant. The earlier operation can be performed the better the chance of saving life, unless profound shock may counsel delay. If the patient be in fairly good condition it is probably safer to explore unnecessarily than to lose precious time with the perforation. The possibility that perforation may result in a local peritonitis only, which can later be opened or may discharge through the bowel or elsewhere, is not to be counted upon. The statistics of laparotomy for typhoid perforation are steadily improving with prompt diagnosis, early operation, and the acquirement of the necessary skill by a larger number of the profession. In a recent hospital case the symptoms were so strongly suggestive of perforation that the belly was opened, but no perforation found. Nobody would have suspected from the chart that any operation had been done, or, if informed that it had been done, been able to fix its date, and recovery was uneventful. Severe pain at the

time of, or following, the perforation may warrant a hypodermic of morphia in spite of the mask which this drug is liable to throw over the symptoms. The promptness with which a decision as to operation and the performance thereof can be reached is a factor in the use or withholding of morphia. A hot flaxseed poultice, if the weight can be borne, or dry heat which can be maintained by a Japanese hand-stove, with which every house should be provided during health as a provision for illness, can do no harm and may notably alleviate pain.

Harte and Ashhurst (2) collected and analyzed three hundred and sixty-two cases of operation for typhoid perforation, with a mortality of 74.03 per cent. The following table shows the relative mortality in twelve-hour periods:

					Total No. Cases.	Mortality.
Operation first 12 hours after perforation....					130	73.0%
“ second 12 “ “ “					84	73.8%
“ third 12 “ “ “					31	93.5%
“ over 36 “ “ “					55	67.2%

It is reasonable to hope that the next statistics of operation for this purpose will show a lessening mortality.

Circulation.—The principles underlying the treatment of circulatory disturbance and failure in typhoid fever are the same as in other specific fevers. The duration of the disease and its natural termination by lysis are factors of import. The failure of the heart is far more apt to be due to the poisoning of the nervous centers than to myocardial changes, a fact which goes far to explain the lack of success which too often attends our efforts. Unless the pulse exceeds 120 in rate, or the first sound is specially feeble, it is seldom desirable to employ alcohol or other so-called heart stimulants. My position with regard to alcohol has been stated under food. A heart beating 120 per minute and showing a tendency to rise in rate will bear close watching and careful consideration at each visit. I have not found digitalis and its congeners often of value, save in as far as the giving out of the heart may be due to dilatation, i. e., myocardial change. Digitalis is, I think, best given in tincture and injected deeply in a muscle; absorption is more sure as well as more rapid than from the stomach. Ten or fifteen minims or more can be thus given twice a day. Strychnia is a very fashionable cardiac stimulant at present. It is best given under the skin, gr. 1/60 (.001) to 1/20 (.003), every three to eight hours. The sodio-salicylate of caffein, two to four grains (.13 to .26) subcutaneously every four to six hours, has now largely supplanted strychnia in the Massachusetts General Hospital. Camphor, conveniently available in the form of camphorated oil, a 10 per cent. solution, can also be injected under the skin and repeated as often

as may seem desirable. Its effects are, of course, transitory. So also ether. Dry heat locally applied seems to be an efficient heart stimulant.

Ortner (7) calls attention to phenomena which he attributes to diminished vasomotor tonus of toxic origin: namely, diastolic and pseudocelerity of the pulse, pulsation of the smaller arteries, capillary pulse and centripetal venous pulse. Signs of increased cardiac activity, particularly a stronger apex impulse and increased aortic second sound, may indicate that the heart is not primarily at fault. In the circulatory collapse which may supervene salt solution under the skin or intravenously is called for and may be followed promptly by improvement.

The Lungs.—Bronchitis, in greater or less degree so frequently a feature of typhoid fever, very seldom needs any drug treatment, as by expectorants or sedatives. Cyanosis is far more apt to depend on general toxemia and cardiac weakness therefrom than upon the mechanical interference with blood oxygenation caused by bronchial secretion. Hypostasis may often be prevented from passing into pneumonia by changing the patient's position every few hours from the back to one or the other side, and by treatment designed to support the heart, *q. v.* If pneumonia of any form supervene, the windows should be more fully opened and no effort spared to keep the heart going. I have found the effect of oxygen inhalation far more effective and lasting since I have learned to pass the gas through absolute alcohol instead of through water. A very rapid respiration with relatively or sometimes perfectly clear lungs is, of course, toxemic and can be influenced, if at all, only by means calculated to counteract the toxemia. It is a rare feature and has not seemed to me of specially serious import.

The Genitourinary Tract.—Those rare cases in which the disease in its onset or early stage seems to vent itself on the kidneys especially, which can be mistaken for acute nephritis of other origin, and to which the Germans have applied the term "nephrotyphus," do well, as far as I have seen, the renal process soon subsiding. In such cases the diet should be that adapted to acutely disabled kidneys, and no bathing other than careful sponging under the bedclothes, or a hot, wet pack, is permissible. About the time of the Spanish War (1898), it became common knowledge that a pure culture of the typhoid bacillus may pass off in the urine. This does not seem to damage the kidneys or to do the patient any harm; but it is, without question, a means by which the disease has been much spread in the past, and the danger is more insidious even than that from the intestinal output, in that the inoffensiveness of urine makes people less careful where they deposit it and less scrupulous about washing their hands. Moreover, one urinates five or six times a day, but ordinarily one defecates only once. There is much and skilled labor involved in repeated examinations of the urine to find whether or not it contains typhoid bacilli and is thus specially dangerous.

In 1898 I began the routine treatment of giving every patient with typhoid hexamethylenamin, $7\frac{1}{2}$ to 10 grains (0.5 to 0.7) every eight hours for two successive days in each week from entrance to discharge. So prompt and so absolute are the effects of this agent on the bacillus typhosus that I felt we could safely disregard frequent examination of the urine for that germ. For the past few years, in compliance with the request of the State Board of Health, which was carrying on some comparative studies, all my hospital patients have had the drug in the above doses thrice daily until discharge. The cases in which the use of the remedy, whether intermittent or persistent, has caused any untoward symptoms are very few, and these symptoms rapidly subside on stopping the drug.

Gastric Irritability.—Gastric irritability, with or without vomiting, may be a more or less constant feature of the disease and give rise to the term, now happily nearly obsolete, “gastric fever.” It is far more apt, however, if it occurs at all, to be temporary or initial, though it may appear at any period. If initial the symptom usually soon subsides under rest and light judicious feeding. It may, however, be well to give the stomach absolute rest for a day or more and resort to seepage, enemata, or salt solution under the skin, as may seem wise. The extra-gastric means of alimentation are apt to be more needed, and, if called for, to demand greater vigor in their application when obstinate vomiting occurs late in the disease which has sapped the strength and seriously drawn on the reserve supply of fat. If the character of the vomitus and other signs suggest that the vomiting is due in whole or in part to food retention in the stomach, the organ should be washed, sometimes a useful procedure in obstinate vomiting from any cause.

The drug treatment of the condition is quite subordinate to that sketched above, and differs in no essential from that applicable to the irritable stomach of any severe infection, which is far more likely to impair than to increase normal glandular secretion. Thus is explained the favorable effect of the mineral acids, especially of dilute HCl. Sometimes cocain in one-fourth grain (0.02) doses seems of service. Very rarely morphia, in hypodermic form, is called for, but is not to be given without serious consideration of all the features of the case and of any valid contraindication to its use which may be present.

Management of the Bowels.—The demonstrated presence of typhoid bacilli in the blood in the earliest periods of the disease, even before fever appears, should give the death blow to efforts either to abort the disease or to modify its course by preliminary purges and so-called anti-septic treatment of the bowel. As far as my experience goes, more than half the cases have no diarrhea at any time, unless as a result of drugs. A dose of calomel can do no harm, especially if the bowels have not been fully opened, when the patient first comes under observation. It is to be always borne in mind that diarrhea, if present, is an expression of catarrh rather than of the ulcerative process. With a diet suited to the special case, and good nursing, troublesome diarrhea is rare. It is to be

treated much like diarrhea arising under other circumstances: by a mild laxative if retention is believed to be a factor in its production; by diet, by bismuth, in doses seldom exceeding twenty grains (1.3), preferably the subcarbonate; or such other astringents and correctives as may seem or prove to be advisable. If the discharges are very foul, betanaphthol may be added to the bismuth. Paregoric is sometimes useful. In the more obstinate cases one of the stronger opium preparations, as opium in powder or extract or tincture, may be called for. An irritable stomach may make it desirable to give the opium in a small enema with starch, or in suppository.

Meteorism is apt to be difficult to overcome. Save in exceptional cases, where it is due to faulty chemistry in the gut and passes off with rectification of the same, it is an expression of poisoned nerve centers and a paretic bowel. Of course, the prime object is to lessen or overcome the toxemia, as we try to overcome any septicopyemia, a difficult task at the best, sometimes quite beyond our power. Turpentine stupes and the rectal tube may be used. With turpentine internally in typhoid fever, save as an addition to an enema, I have no experience, and confess to being afraid of it. In desperate cases puncture of the intestine with a fine hollow needle or trocar and cannula has been practiced. With this, again, I have no personal experience. [I, also, am afraid of *this* measure.—Editor.]

I know nothing comparable to an ounce or two of pure glycerin in the rectum as an aid to the expulsion of intestinal gas. If peristalsis can be instituted glycerin is pretty sure to do it; but the danger of thus causing perforation and hemorrhage has deterred me from its use in typhoid fever. Some surgeons are enamored of an enema of soapsuds with glycerin and Epsom salts. Thus diluted I believe the glycerin to be nearly inert. In cases requiring artificial aid to move the bowels the safest reliance is on enemata, which I am apt to use every other day. Some give them daily. It is very rare that a laxative by the mouth is called for during the height of the disease. As convalescence approaches or is entered on, the possibility that a continuance or recrudescence of fever may be due to fecal retention is to be kept in mind. I have repeatedly seen what I feared might be a relapse disappear after castor oil, calomel, or another mild laxative, and an enema, resulting in free evacuation. If a few ounces of olive oil, or what is commercially called such, can be retained in the bowel for some hours, it may help to clear the lower intestine by softening the fecal masses.

Insomnia.—Insomnia may be troublesome and require attention at any period in the disease. Notable cardiac weakness seems to me to contraindicate the use of the coal-tar products, trional, veronal, sulfonal, sodium-veronal. Personally, I do not believe chloral to be the heart depressant it is credited with being by many. A bromid, chloral, or a combination of the two, often proves all that is necessary. If there be active delirium which is not quieted by bathing and ice to the head, opium in some form, preferably morphia under the skin, is called for and

may be repeated, if it acts well, in such doses and as often as the features of the particular case may seem to demand. Sometimes hyoscin hydrobromate, 1/100 to 1/200 of a grain (.0015-.0007), injected under the skin, acts better than anything else. On the other hand, I have known it to increase delirium. This seems to me largely a matter of idiosyncrasy, not determinable beforehand. The danger of intensifying the delirium has led me to limit the use of hyoscin to those cases in which morphin and other measures fail. Sometimes hyoscin and morphin combined act better than either alone. When combined, a rather smaller dose of each should be given than of either alone.

Headache.—This symptom is rarely prominent or troublesome except in the earlier stages of the disease and, therefore, before the heart has begun to weaken. Severe headache seems to me the only justification for the use of a coal-tar antipyretic in typhoid fever, and often one of this class of remedies proves serviceable for the purpose. No one of these preparations is safer than phenacetin, which should always be combined with caffein, one grain (.065) of the latter to five (0.3) of the former. The first dose of phenacetin should never exceed five grains (0.3), presence of fever from any cause seeming to diminish the tolerance of this class of remedies. It is wiser not to repeat the dose in less than two hours. Repetition and the frequency thereof must be a matter of careful judgment. If neither relief nor untoward results follow, the dose may be increased, but very cautiously and under trained observation. Now and then this symptom can be relieved only by a hypodermic of morphia. The ice-cap may help.

Nose-bleed.—Epistaxis rarely needs any treatment. I have once seen death occur from hemorrhage, uncontrolled or uncontrollable. Measures to stop excessive bleeding are essentially the same as for nose-bleeds under other conditions; compression of the nasal arteries, ice to the nose, adrenalin locally, or plugging the nares. As a rule, epistaxis is an early symptom and occurs before pronounced weakness has developed. Whether and how much the patient is to be propped up in bed, as a means of stopping his nose-bleed, depends on his general condition and the stage of his disease.

Parotitis.—This, though uncommon, is more likely to occur in severe cases rather late in the disease, and is usually dependent on an ascending infection by pus-forming organisms in the mouth. The more rigid the care of the mouth the less is the liability to this complication. Its occurrence is an indication for the use of alcohol or for an increase in its dose if the patient is already taking it. Either ice or a flaxseed poultice may be applied, preferably that which affords the more relief to pain. Incision may, or may not, be necessary.

Periostitis, Orchitis.—Periostitis and orchitis, also late complications, are more apt to be due to the typhoid bacillus and usually subside under

treatment suitable to such inflammation apart from typhoid or syphilis. I cannot now recall a case in which incision proved needful, though such occur. Probably in these cases there is a mixed infection.

Mastitis.—I have never seen mastitis. It may or may not suppurate. Its treatment is the same as when it occurs independently of typhoid.

Otitis.—Otitis, largely, as I believe, preventable by rigid care of the mouth, is to be treated practically in the same way as when it arises under other conditions.

Gall-bladder Affections.—Cholecystitis, with or without gall-stones, and perforation may occur either as complications during the disease or as sequelæ, even many years after the general infection. The treatment of perforation is always surgical, and if prompt and skillful is apt to be curative, more so than intestinal perforation, bile, even if mixed with pus, being far less noxious to the peritoneum than fecal matter.

If cholecystitis be suspected, surgical counsel should be had. Whether a prompt operation should be done must depend on the urgency of the symptoms and the state of the patient. No absolute rule can be laid down. Acute inflammation may subside spontaneously, with loss of all symptoms, permanently or for a time. Mason (5) reports an interesting case in which recovery followed tapping of the gall-bladder, the condition of the patient being thought not to warrant incision.

Those interested in the surgical aspects of typhoid, not only those referred to in this article, but also those so rare that it has not seemed worth while to detail them here, will do well to consult Keen's "Surgical Complications and Sequelæ of Typhoid Fever."

Phlebitis.—Phlebitis, one of the more common sequelæ, is to be treated precisely as phlebitis arising under other conditions. Moist heat certainly promotes comfort during the early and active stage, even if it is uncertain whether it exerts a directly beneficial influence on the process. Moist heat is best applied by the flaxseed poultice, old-fashioned though it may be. When the saphenous vein is occluded, the whole thigh or even leg may be enveloped in the poultice, which should be renewed every two hours. The cooling of the poultice can be delayed by putting one or more Japanese hand-stoves (Kiro) over it. Large swelling will automatically tend to limit or do away with active motion, which it would seem reasonable to believe tends to enhance the chief danger of phlebitis, clot detachment and pulmonary embolism. Caution is to be exercised in the use of massage after the subsidence of active symptoms. It should be begun in a light form below the plugged vessel, which is to be let severely alone, certainly until cording has entirely or largely disappeared. The gentle support afforded by a well-fitting bandage made of flannel, cut bias, or by the Bender bandage, so-called, will be found useful until the old channel is fully reopened or adequate new channels are formed.

Tender Toes.—Tender toes are to be protected from the contact of the bedclothes by a cradle. A 25 per cent. alcohol solution of menthol applied locally may yield marked relief.

Typhoid Spine (*Spondylitis*).—From a therapeutic point of view, early recognition followed by prompt and efficient fixation are the important things.

Post-typhoidal Psychoses.—Psychoses following typhoid have a good prognosis. Whether asylum or sanatorium treatment is desirable must depend for decision on the circumstances and features of the individual case.

Furunculosis.—Furunculosis may be a very painful and distressing complication. It may be due to the pus-forming organisms, to the bacillus typhosus, or to both combined. The utmost cleanliness of the skin is to be enforced and the foci are to be opened and drained, if necessary, as soon as ripe. If the boils are caused by the staphylococcus or other common pus-producer, an autogenous vaccine is indicated. If caused by the bacillus typhosus it would seem rational to use in severe cases an autogenous vaccine of that organism, though I have not been able to find reports of cases in point.

So also in rebellious localized lesions due to the typhoid bacillus such a vaccine should be tried. Moffitt (6) reports a case of obstinate, recurrent bone lesion which repeated operations failed to cure. An initial dose of forty million heterologous typhoid bacilli caused distressing general reaction with depression and malaise for days. Later, treatment was resumed with one million, gradually increased to one hundred million, followed by final recovery.

TREATMENT DURING CONVALESCENCE

This, unless the attack has been very mild, is likely to be tedious. The patient is left empty, swept, and ungarnished. If he has been liberally fed during the fever, the loss in weight will not be very great; fully as much, if not more, in muscle than in fat. For at least two weeks after the subsidence of the fever any article of diet leaving irritating residue should be avoided, lest perforation be encouraged. The change in diet is quantitative, rather than qualitative. If, however, he has been fed exclusively on liquids, the change should be in both directions. I note that Forchheimer encourages his convalescents to acquire the objectionable habit of chewing gum to allay their pangs of hunger, and naïvely says that it does no harm. It seems to me more rational to forestall the pangs of hunger by allowing chewable and innocent food. Anyway, I would rather at the dreadful day of judgment face the accusation of having delayed somewhat the convalescence of my patient than of having taught him to chew gum and live on his own saliva. The gain in weight,

which I have seen exceed two pounds a day, is at first mainly in fat. Muscle tissue is not replaced until it is used. Nervous strength may be the last to return. Nervous overfatigue is to be carefully avoided, whether from injudicious, or too many, visitors, or other cause. A fool visitor or a domestic or business worry can produce moderate elevation of temperature and retard recovery.

The consciousness of daily returning strength and an actively efficient digestion ordinarily help to reconcile the patient to any restrictions which are placed upon him. He sits up, first on a bed-rest, then in a chair at the bedside, then in the sunshine at an open window, with a daily increase in time, provided he thrives on it. I have repeatedly seen slight elevation of temperature persist until the patient is allowed to sit up. This is what may properly be called "bed fever." Other causes of temperature are to be sought for and eliminated before increasing activity. One of the chief of these is fecal retention, for which a mild laxative may be given by the mouth if full relief does not follow an oil or suds enema. Nothing like a fixed rule can be laid down as to how soon ordinary life can be resumed. The age of the patient, the severity of the infection, his individual reparative power, all the circumstances of his life, including the character of his work, his attitude toward it, his ability to abstain from a gainful occupation with that peace of mind which is so conducive to nutrition—all these things are to be considered. It is sometimes a year before he is good for much, well enough to resume an arduous and exacting calling; and yet financial considerations sometimes necessitate earlier resumption of work than is well or wise. Other things being equal, full power will be recovered more rapidly by the muscle, than by the brain-worker. Convalescence is apt to be very slow in patients contracting the disease at or after middle life, I suppose because all vital processes are then slacked up. If feasible, a thorough change of scene with the maximum of outdoor life is desirable before the return to ordinary life.

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CHAPTER II

TYPHUS FEVER

ALVAH H. DOTY

Typhus fever is an acute infectious disease abruptly ushered in and associated with a general eruption and an early and profound involvement of the nervous system. There is no other affection which so strikingly ends by crisis. This uniformly occurs on the twelfth to the fourteenth day from the invasion.

There are three diseases which in the past have been responsible for great loss of life, particularly in Western Europe, where from time to time they have appeared under the general term of "Plague." These are cholera, plague, and typhus fever. The devastation which has followed their appearance is frequently referred to in medical literature even prior to the Christian era. In some instances the history of these outbreaks has served to identify the disease involved; more often it is difficult to determine which one is referred to.

While cholera and plague are still active, and constitute a frequent menace to the public health of the world, typhus fever has in recent years largely disappeared, its presence being confined to certain limited areas. On this continent, with the exception of cases still reported in Mexico, I am aware of no outbreak which has occurred during the past twenty years.

Nothing more clearly and brilliantly reflects the value of modern sanitation than the marked decrease of typhus fever throughout the world, for it is intimately associated with filth, overcrowding, and bad sanitary conditions, and for this reason has received the name of "prison fever," "ship fever," "jail fever," etc., indicating the favorable conditions for its appearance and dissemination.

The outbreak of typhus fever which appeared in Ireland during the famine occurring between 1813 and 1818 is still fresh in the minds of those who are familiar with the history of this disease. A long period of cold weather and the failure of the potato and other crops were followed by great destitution, overcrowding, and other extremely unfavorable sani-

tary conditions. During the latter part of 1816 typhus fever, which had been present for some time, extended with great rapidity and it is estimated that one-eighth of the population of Ireland contracted the disease. It is a significant fact that its disappearance followed the plentiful harvest of 1818.

It is not unfair to state that the prolonged presence of typhus fever in a locality reflects unpleasantly on the means which have been employed in dealing with it.

The improved methods which are now in operation at foreign ports of departure in the observation, medical inspection, and, when required, detention of those about to embark serve as an added protection against the importation of typhus fever through the medium of incoming vessels.

[The work of the lamented Ricketts in connection with the transmission of typhus fever by lice seems to be conclusive. He, jointly with R. M. Wilder, showed that body lice, *Pediculi vestimentorum*, transmit the disease. Monkeys were infected after being bitten, after being injected with blood from typhus patients, and by inoculation with infected lice. Subsequently these two observers showed that neither fleas nor bedbugs can carry the infection and lastly R. M. Wilder (1911) again emphasizes this point, and states that *Pediculus vestimentorum* stands incriminated for transmission of the disease.

In the epidemic of 1875 in Vienna I saw cases of typhus fever in the medical wards of the Allgemeines Krankenhaus, together with all other patients. No precautions were taken to prevent infection of others. Listening to a ward lecture I found myself sitting upon a bed from which the corpse of a patient dead of typhus fever had just been removed. Not one of the physicians, students, or patients were infected. Because of the work of Hebra, *Pediculi vestimentorum* no longer existed in this hospital, in view of which the work of Ricketts and Wilder seems to offer an explanation.—Editor.]

Methods of Transmission.—Although the specific organism of typhus fever has not yet been identified, various theories have been suggested as to the means by which it is contracted. It has been generally accepted that it is transmitted through the medium of fomites; this applies to such articles as bedding, clothing, baggage, etc., which are believed to convey the organisms of the disease in its active state from one person to another. This theory has been handed down from one generation to another with no definite scientific proof to sustain it, although it has been accepted as the ordinary or common means by which typhus fever as well as other infectious diseases are transmitted. In recent years careful investigation has shown the fallacy of this belief and our present knowledge of this subject justifies the statement that clothing, money,

baggage, cargoes of vessels, etc., are media of infection only in rare instances and that infectious diseases are transmitted from one person to another by contact, by the discharges in their active state of those who are infected, and by insects and vermin. Investigation of this subject in connection with typhus fever, particularly that recently carried on in Mexico by Goldberger and Anderson of the U. S. Public Health and Marine Hospital Service, indicates that this disease is transmitted by the body louse. If these results are confirmed, as they are likely to be, they will largely explain certain peculiarities of infection which come under the observation of those who are practically familiar with this disease. Furthermore typhus fever is notoriously confined to persons of the class who naturally would be the host of these insects.

During the outbreak of typhus fever in New York City in 1892-3 about 700 cases were dealt with by the Department of Health, and there were not more than two of the patients from the better walks of life, those affected being a part of the lodging and tenement house population, particularly among the patrons of the Bowery lodging houses. The latter were subjected to a thorough cleansing and disinfection and the inmates were kept under careful observation to detect the early appearance of the disease. Within a month after this special regulation was enforced the last case of typhus fever appeared in New York City.

There is not only no definite knowledge regarding the specific organism of typhus fever, but there is practically nothing to identify it at the autopsy. The changes found are as a rule only those which appear in other acute infectious diseases.

Incubation.—The incubation of typhus fever covers a period of from eight to twelve days, although it may be of even shorter duration. The invasion, however, is very brief, the onset of the disease being sudden. This constitutes an exceedingly important point in the differential diagnosis, for typhoid fever, for which it is commonly mistaken, has a prolonged period of invasion.

Symptoms.—*Eruption*: The identification of no other disease depends so fully on the eruption. Without it a diagnosis cannot consistently be made. However, while the specific organism remains undetermined, cases of continued fever without an eruption, the identity of which cannot be established, occurring during an outbreak of typhus fever should always be isolated until a definite diagnosis can be made. The importance of recognizing the first or early cases is apparent, for their isolation goes far toward limiting the extent of the disease. Few physicians, even those who have been long in practice, have seen typhus fever, and it is not surprising that it should be often overlooked unless preceding cases have occurred.

I cannot too strongly emphasize the statement that where typhus fever is suspected other signs and symptoms should receive secondary consideration until the eruption is carefully studied, particularly where it has reached its typical stage.

While there are certain general infections which may produce an eruption somewhat similar to typhus fever, it is not common; these exceptions will later be referred to.

I remember having seen but one case where typhus fever was suspected without the presence of an eruption. This was at Mt. Sinai Hospital, New York City, during the outbreak of 1892. The case was ushered in with symptoms similar to those of typhus fever, and the character of the temperature followed quite closely the course of this disease and ended by crisis about the end of the second week. Still there was no eruption and the diagnosis was never fully determined.

The eruption of typhus fever generally appears on the second or third day; it is usually present when the physician first sees the patient. Some authors improperly refer to the eruption as "rose"-colored macular spots which disappear on pressure. This is not the true typhus eruption and should not be considered as such, but is only a preliminary stage of it; besides something of this character of eruption occurs in other infectious diseases, also.

The true or diagnostic eruption of typhus fever is petechial and relates to minute hemorrhages in the center of the spots. It can easily be understood that such a condition would occur in the presence of great prostration and weakness of the vascular system. Practically, the eruption is general throughout the body and may be particularly well studied on the flexor side of the forearm or about the shoulders. The eruption does not occur in successive crops as in typhoid fever, but as one crop, although it may be irregular in arriving at its completion. It may last eight or ten days, and is usually present when death occurs, prior to the end of the second week. In some cases a slight desquamation may sometimes follow. However this is unimportant and has no special diagnostic value.

A more minute description of the eruption is as follows: at first it does not assume its true character but appears as a rash which may sometimes be mistaken for measles. The spots are irregular and vary in size from a pea to those which are much smaller. They may be isolated or rather grouped in patches. They do not at first present the characteristic dark appearance and may disappear on pressure. The eruption generally presents itself first on the chest and abdomen and afterwards on the arms and thighs. On the face and neck it is not only not pronounced but frequently may not be detected. This has been ascribed to the very vascular condition of this part of the body, added to the extreme hyperemia which occurs in typhus fever. There is some reason to believe that this is the proper explanation. In addition to the eruption above referred to, a mottling of the skin occurs. The early eruption soon changes its character. The spots become darker in color and do not disappear on pressure. Subsequently there appears in the center of the eruption a dark bluish spot

known as petechiæ, due to an extravasation of blood. This practically represents the true eruption of typhus. To complete the picture—to this must be added a dusky or congested appearance of the skin in general; in other words the eruption lies on this instead of the skin in its normal color as occurs in the eruptions of typhoid fever.

Chills.—Typhus fever is rapidly ushered in by chilly sensations, or in some cases the first intimation of the disease may be a chill. There is early and great prostration, the temperature quickly rises, and the nervous system becomes rapidly involved and delirium early appears. This becomes marked and continuous and not uncommonly assumes an active form. The pronounced cerebral complication is highly characteristic of typhus fever, and it is this which suggested its name indicating a “cloudy” mental condition. The eyes become early and rapidly suffused; this injection of the conjunctiva constitutes a very important symptom.

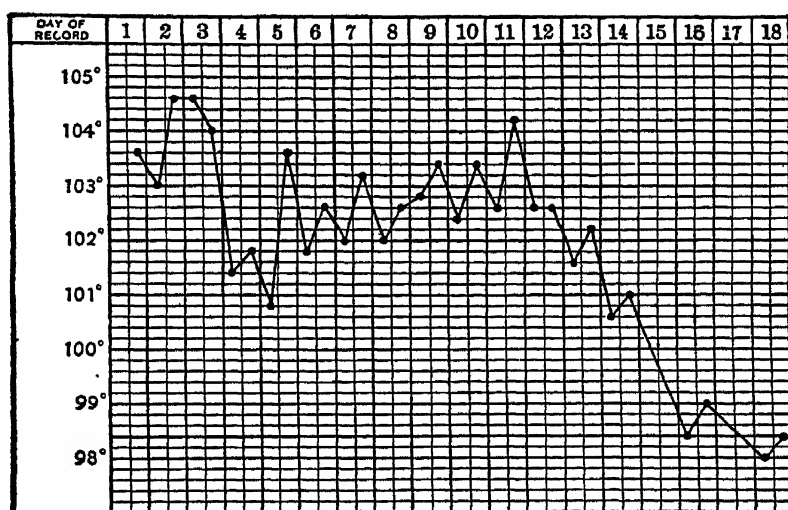


FIG. 1.—CASE OF TYPHUS WITH GRADUAL DECLINE OF TEMPERATURE, FOLLOWED BY RECOVERY.

Temperature.—The temperature curve is very characteristic, and is best understood by a study of the accompanying charts, which are very typical and which indicate the range of temperature in actual cases during the epidemic of typhus fever in New York City in 1892-3. The temperature rises rapidly and usually attains its height about the fourth or fifth day, when it becomes rather stationary, with a more decided diminution in the morning. After the ninth or tenth day in favorable cases the temperature begins to decline and usually continues so until recovery. As has already been stated, there is one factor present which is more prominent and constant than in any other disease, i. e., the termination of the disease by crisis about the fourteenth day. It is very important

that this should be borne in mind, particularly in doubtful cases. Furthermore, the prognosis of typhus fever should be guardedly given, for some of the most serious and apparently hopeless cases at the end of the second week are, after a deep and refreshing sleep, followed by a surprising change for the better.

While typhus fever is more readily propagated during the cold months, due to the fact that overcrowding, etc., is more frequent, it may occur at any season of the year.

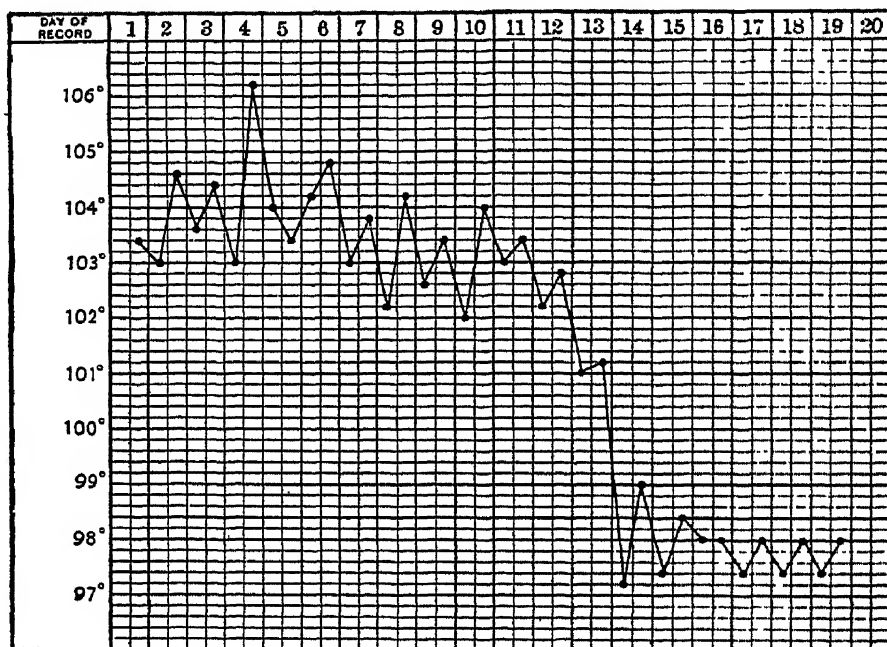


FIG. 2.—CASE OF TYPHUS WITH DECLINE OF TEMPERATURE BY CRISIS, FOLLOWED BY RECOVERY.

Prognosis.—Age has largely to do with the prognosis. Children do not often die from it, and those who succumb are generally beyond youth. The mortality is very high after middle age, particularly among those who are addicted to the excessive use of alcohol. One attack generally confers immunity.

Treatment.—There is no specific for typhus fever, and but little can be done in the way of medication except the use of remedies to relieve the insomnia or delirium, reduce the fever, and strengthen the heart. However, these agents should be used with great caution, for there is no doubt that in many instances what little chance of recovery the patient may have had has been dissipated by the injudicious use of medicine. Certain preparations are suggested by various writers as particularly valuable in typhus fever. My own observation does not confirm this. Alcohol is indicated, but its effect should be carefully watched.

Cold applied to the head is usually grateful, and cold sponging or cold

baths are frequently employed with good effect, although the latter procedure, by disturbing or exhausting the patient, is often contraindicated. The result in each case should determine if this treatment should be continued.

I believe that nothing gives to the patient so good a chance of recovery as fresh air, and if the weather permits there is no reason why he should not, under proper bodily protection, be removed to the outside and derive great benefit from it.

During the outbreak of typhus fever in New York City in 1892-3 the hospital accommodations for this disease were inadequate and a tent service was provided in the grounds at Bellevue Hospital during the winter months. The difference in the mortality of cases treated in the hospital wards and in the tents just referred to soon becomes very apparent, being much less in the latter. It must be borne in mind that in this disease we deal with a profound systemic infection, and there is abundant and continued proof that fresh air and its stimulating and tonic effects are of inestimable value in these conditions. The use of medicine under these circumstances unless they are specifically indicated is sometimes followed by unpleasant results.

The most careful attention should be given to the administration of nourishment, which is of great importance. Articles should be chosen which, within proper limitations, are most acceptable to the patient. Kumyss is very gratefully received and is very valuable as a nourishing agent.

[In an epidemic in Madrid, Castellói saw 311 cases in his hospital service. The epidemic lasted from February to June, 1909. He first discovered the fact that in this disease polymorphonuclear leukocytosis is the normal condition. His results are very interesting and suggestive. With purely symptomatic treatment, 13 out of 113 patients died. With Frehier's artificial phlegmon, injection of 1 c. c. of turpentine, 9 out of 29 died. With subcutaneous injection of collargolum, 1 out of six; with electrovargol, one out of two, when given by intravenous injection (two treated) none died. With injection of normal saline solution, 250-300 c. c. at a time and from 600 to 1,800 c. c. a day, only 9 out of 136 died. With streptococcus serum, two out of 16 cases, and with diphtheria antitoxin, 1 out of 9 cases lost. He also employed convalescent serum in one patient who recovered. The last mode of treatment cannot be taken seriously, as its application in a great epidemic is out of the question; moreover its employment is fraught with so much danger that it cannot be used frequently, although Legrain has employed it successfully in 12 cases. From Castellói's experience it would seem that, when there is a sufficient number of cases, injection of normal salt solution and purely symptomatic treatment give the best results. When serum was given, 26

cases in all, only three died, suggesting the possibility of the action of a complement in the serum.

There is no shortening of the course of the disease, but its indications are the same as in typhoid fever. Those who have employed antipyretics claim that they have no effect upon the course of the temperature and very little effect upon the temperature. They may, however, be administered for other purposes as in any other condition.

Bed sores should be prevented by all possible care and attention as, in this disease especially, they may quickly develop into a formidable complication.

The convalescence is slow, it is accompanied by debility and anemia. Good, nutritious food, easily digested and in not too large quantities, should be given. Ferruginous tonics seem to be most valuable for the anemia. The patient should not return to his vocation until after all the symptoms have disappeared.—Editor.]

Differential Diagnosis.—Typhus fever may be mistaken for typhoid fever, measles, cerebrospinal meningitis; less frequently pneumonia, and in some instances other acute infectious diseases.

In typhus fever the invasion is abrupt; in typhoid fever it is prolonged, frequently covering an indefinite period. This is an exceedingly valuable point to bear in mind in deciding between these diseases, which most frequently calls for a differential diagnosis. In typhus fever the disease begins with a rapid rise of temperature, chill or chilly sensation, profuse headache, and early and great prostration and involvement of the mental faculties, a suffused congestion of conjunctiva, and an eruption which appears on the second or third day of the disease. In typhoid fever there is a slow rise of temperature, no profound impairment of mental faculties in the early stage, no injection of the conjunctiva, and the eruption does not appear until the second week of the disease. Besides there are symptoms referable to the abdomen, and the "Widal" reaction may be obtained in typhoid fever. In typhus fever the true eruption is petechial and generally distributed about the body, appears in one crop only, and does not disappear on pressure, whereas the eruption in typhoid fever is generally confined to the abdomen, is rose colored and papular, occurs in successive crops, and does disappear on pressure.

The differential diagnosis between typhus fever and measles should be easily determined, particularly after a day or so. Typhus usually affects the adult, while measles generally occurs during childhood. While measles appearing in the adult may call for more caution in the differential diagnosis, the profuse eruption, which occurs always in conjunction with pronounced catarrhal symptoms, and with but little or no involvement of the mental faculties generally, indicates the diagnosis.

If care is used malarial fever can hardly be confounded with typhus

fever; at least no longer than is necessary to observe the periodicity and to detect the plasmodium.

Meningitis, particularly the cerebrospinal form of it, may, for a short period, in some instances be mistaken for typhus fever. However, the invasion of cerebrospinal meningitis is even more abrupt than typhus fever; it usually occurs at night with really no premonitory symptoms; vomiting, which is a very common symptom in cerebrospinal meningitis, does not often occur in typhus. Rigidity of the nape of the neck and opisthotonos constitute the most important signs in cerebrospinal meningitis, whereas they have no special relation to typhus fever. Furthermore in cerebrospinal meningitis death usually takes place in from one to three days and in typhus fever the duration of the disease is much longer. An eruption does not always occur in cerebrospinal meningitis. When present it has no definite or special form and can easily be diagnosed from that of typhus fever.

A careful examination of the chest will usually identify pneumonia, which is not a complication of typhus fever, the pulmonary involvement in the latter disease being confined to bronchitis.

In the presence of a suspected case of typhus fever, or in the differential diagnosis between this and other diseases, every effort should be made to ascertain if previous cases have occurred in the locality or in any section from whence the patient may recently have come, for this has an important bearing, particularly in doubtful cases.

Occasionally what may be called a septic eruption appears in typhoid fever. In some instances this is profuse, covering a large portion of the body. I have seen a number of cases of this character mistaken for typhus fever. It is to be identified by adhering closely to the differential diagnosis already referred to in connection with these diseases. This rather unusual eruption in typhoid fades away within a few days after it appears. Furthermore it is found on a background of apparently normal skin.

In one fatal case under my observation the patient had an eruption which was extremely suspicious of typhus fever, the skin having in addition to the eruption a cyanosed appearance; the autopsy showed a very extended suppuration of the right kidney, from which was removed a concretion half the size of a hen's egg. While cases of this kind are rare they should be thought of when the presence of typhus fever is suspected, particularly if there is no history of exposure to this disease and no outbreak has been reported.

CHAPTER III

SMALL-POX

JOHN RUHRÄH

Synonyms.—Latin, *variola*; French, *la variole*; German, *Blattern* or *Pocken*; Italian, *vaiolo*; Spanish, *viruelas*.

Small-pox is an acute specific infectious disease characterized by a sudden onset, an initial fever lasting three or four days, followed by a characteristic eruption which passes through the stages of papule, vesicle, and pustule, and finally dries and drops off, very often leaving more or less typical scars. The fever usually ceases or becomes intermittent on the appearance of the eruption and recurs when the vesicles change into pustules.

Small-pox has been known from very early times, particularly in China, and, while there is every reason to believe that it was present in the various countries, the older writers did not give very clear descriptions of it. About the first century, however, there can be little doubt of the presence of the disease, and numerous widespread and severe epidemics have been reported. The first accurate description is perhaps that of Isaac, but the best of the early descriptions is that of Rhases, who lived in Bagdad about 900. The disease was at first confused with measles, from which it was distinguished by Avicenna (980-1037), and Sydenham finally gave such a description as to lead to the separation of the two diseases, and he also changed the treatment of the disease into what might be regarded in the main as that of the present day, in that he believed in plenty of fresh air and the use of cooling applications, in place of sweats and the numerous other methods of treatment previously in use. The disease was probably imported from the old country to America early in the sixteenth century, and there were numerous epidemics which exterminated many Indian tribes, and reduced others to a handful of individuals. One thing which is often overlooked in thinking of small-pox is the fact that in prevaccination days every one had the disease, and at that time it was a disease of childhood, the adult population consisting of those individuals who had survived the attack which, Lettson states, oc-

curred almost invariably before the seventh year. From the descriptions of writers of that period almost every one was more or less pock marked and the disease was regarded as a disagreeable necessity, much in the light that we now regard measles.

Susceptibility to the disease is quite general and infants do not seem to enjoy the natural immunity to it which they show toward most infections. The disease is known to affect infants *in utero* when the mother has the disease, and young infants exposed to the disease almost invariably take it. There are, however, a few individuals who seem to be naturally immune. This number is perhaps very small, indeed, curious variations in the susceptibility to small-pox exist, just as the same variations are noted in other infections. An individual may be exposed and not take the disease at one time and become infected at a subsequent exposure. One attack usually confers an *immunity* which lasts for the remainder of the individual's life. Second attacks may, however, occur, and there are a few undoubted instances of these on record. Many of the second attacks, however, are due to mistakes in diagnosis, which, in regard to small-pox, are exceedingly common. During two years' service in a hospital which received small-pox I saw every disease that one could imagine coming in to the question of diagnosis mistaken for it. Jenner was a great believer in the immunity conferred by one attack and, while his views may have been influenced by his advocacy of vaccination as a means of producing the immunity in another way, it would seem that he was not very far from the truth.

Small-pox may be present at the same time with other infectious diseases. There is a prevailing impression that the disease is more common in dark-skinned races, especially in negroes, but this is perhaps due to the fact that these races are not as well protected by vaccination. The disease is one which occurs in temperate climates in the winter months, and almost all of the cases are during cold weather. In tropical countries it is said that the worst cases occur during the hottest months.

The Organism.—The organism causing small-pox is now thought to be an organism known as the *Cytoryctes variolæ*. These bodies, which have been studied in the skin, were first described by Weigert in 1874, and were supposed to be parasites by Renault in 1881. In 1892 Guanieri gave the first clear description of what he believed to be a parasitic protozoon, and the cause of vaccinia and small-pox. These bodies have been studied by numerous observers, among whom may be mentioned Councilman and his associates, and most of the reports that have been made tend to confirm the views of Guanieri. This subject, however, is one which is worthy of further study.

The Infective Period.—It is extremely doubtful whether small-pox is transmitted during the stage of incubation, and it is safe to assert that if one takes into account only the ordinary means of transmission there is no

danger from the patients during this stage. The danger begins from the beginning of the symptoms and lasts until all of the scabs have separated. There is perhaps less danger during the last stages of the disease, but there seems to be no doubt that the dry scabs may contain the infectious material and so be a definite source of danger. It should also be borne in mind that the infectious material is present in cadavers and may remain in them apparently for long periods of time; so that the disease occasionally results from such bodies finding their way into dissecting rooms, or from the exposure of small-pox corpses in other ways.

Transmission.—There is still considerable discussion of the ways in which the small-pox virus is transmitted. There can be no doubt that almost all of the cases are the result of direct contact with individuals having the disease. Small-pox may be of such a mild nature as to be almost unrecognized, and an individual with a light attack of the disease going about and mingling freely with other people may cause a large number of infections which would be thought to be due to fomites, aërial transference, or to some other means of acquiring the disease. The disease may be carried in the discharges from the patients suffering with it and also on fomites, although the danger of this is slight if reasonable precautions are taken.

There has been a great deal of discussion on the subject of whether the disease may be transmitted through the air or not, and I believe that aërial transmission, where it does occur, is accomplished by means of infected dust, so that if dust is suppressed aërial transmission need not be considered. Most of the evidence which has been adduced in favor of aërial transmission is from English sources, and consists merely of the fact that large numbers of cases of small-pox have been found in the neighborhood of small-pox hospitals; but the fact that these infections may easily have been due to direct contact was not taken into account. The experience in modern hospitals with appropriate technique seems to prove rather conclusively that the disease may be easily confined by using simple precautions. The disease may be carried on the clothing or person of a healthy individual who has been exposed to the disease, although this is probably less frequent than has hitherto been supposed. Flies and other insects may in some instances carry the disease, although there is no direct evidence to substantiate this. When one sees flies crawling over small-pox patients, especially when the disease is in the purulent stage, and the pustules have ruptured, the possibility that flies may be a means of transmission becomes apparent. In the temperate climates most of the cases occur during winter, so the fly does not, as a rule, in this region play any very distinct part in the transmission of the disease. The disease may be transmitted by physicians and nurses, and yet this danger may be minimized or entirely done away with by the simple application of the same technique as that used in an operating room.

The Incubation Period.—The period of incubation varies somewhat, the disease coming on between eight and fourteen days after infection, with the probability of there being some exceptional cases developing both earlier and later. It is usually thought that if sixteen or eighteen days elapse after exposure the patient will not develop the disease.

PROPHYLAXIS

The prevention of small-pox depends, first, on *vaccination*, and, secondly, on *isolation* and *disinfection*. As to the value of vaccination there can be no doubt. If every one were vaccinated and revaccinated until he was no longer susceptible, small-pox could easily be controlled without any further means. As this is not possible, if we except one or two countries, we must still rely upon the assistance of other measures to protect that portion of the community who wilfully neglect to take care of themselves.

In order to study the disease *notification* should be insisted upon, and where possible the diagnosis should be confirmed by some one familiar with the disease, as it not infrequently happens that other diseases are mistaken for it, and needless precautions imposed, to the great annoyance of the individuals, as well as the great expense. *Isolation* may be carried out either in the patient's home or in a special hospital. Of the choice of the two methods there can be no doubt that the transference of all cases to a small-pox hospital lessens the danger of an epidemic, inasmuch as it reduces the number of foci of the disease. Where, for any reason, the patient cannot be removed, a strict room quarantine should be insisted upon. This is usually enforced by means of special guards under the direction of the health department. Where the patient is removed to a hospital the question arises as to whether *the other inmates of the house who have been exposed* to the disease should be quarantined, or whether some other measure should be undertaken. As a period of quarantine for sixteen or eighteen days entails great loss and also causes those so detained to take every possible means to evade isolation, it is perhaps better to vaccinate all those exposed, using by preference three or four separate inoculations with different varieties of virus, so as to avoid, as far as possible, the vaccinations not taking from the use of sterile virus. These individuals should then be allowed to go about, but inspected daily or even twice a day, so as to be able to isolate them promptly should any symptoms of the disease make their appearance. The room or rooms that have been occupied by the small-pox patient should be disinfected.

A *small-pox hospital* should, if possible, be of modern construction, so that the patient may be made as comfortable as possible. As a rule small-pox hospitals are hospitals in name only, and consist of barnlike struc-

tures with few or no conveniences. The hospital should be away from the center of the community, but at the same time it should not be so far away as to be inaccessible. A building surrounded by a fair amount of lawn should be chosen, where this is possible. The most important feature about the hospital should be the *suppression of dust*, which is usually easily accomplished by washing the floors and woodwork, or by using some of the modern oil preparations for the laying of dust. The *discharges* of the patient should be received in vessels containing carbolic acid, chlorid of lime or bichlorid of mercury, and a sufficient length of time should be allowed to elapse before they are poured out to permit of thorough disinfection. Where it is possible, and it practically always is, a small furnace should be erected, and all *excreta* and *waste* should be burned in this. This is the most satisfactory, the cheapest, and the safest method of the disposal of infectious material. *Bedding* and *clothing* should be disinfected either by boiling, allowing half an hour exposure to boiling water, or exposure to live steam. *Mattresses* should be disinfected by live steam under pressure, and where this is not possible the mattresses should be burned. The articles which are sent to the laundry may be sterilized by an immersion for several hours in carbolic acid, four ounces to the gallon, or zinc chlorid, two ounces to the gallon; or they may be sterilized by boiling, and at least half an hour's time should be allowed for this. *Nurses* and *attendants* should be isolated with the patient, and under ordinary circumstances should not be allowed to leave the hospital temporarily. Where it is desired to have them leave temporarily or permanently they should change all of their clothing, disinfect the hair by the use of carbolic acid solutions, and take a bath, either in bichlorid, 1:5,000, or carbolic acid, 1:40. Visitors should not be allowed, but if under exceptional circumstances they are, they should undergo the same precautions as the attendants. It goes without saying that all persons coming in contact with small-pox patients should be vaccinated.

Physicians should take particular care not to carry the virus upon their clothing or person. This is usually easily avoided by the use of the long gown and a cap for the head. These should be hung in the open air, in the intervals between the visits, and should be frequently sterilized. Where the physician must spend any length of time in the wards the clothing, including the shoes, should be changed on entering, and the hands and face carefully disinfected before leaving. If a gown is worn rubber overshoes should be used to avoid carrying dust or scabs which may be on the floor; or the soles of the shoes should be disinfected on leaving the hospital. By using these means visits may be made to small-pox patients without any fear of transmitting the disease to other individuals, but the technique must be carried out in an earnest manner and in every detail. As long a period in the open air as possible should elapse before making visits to other patients.

The *disposal of the dead* is best accomplished by cremation. Where there is any objection to this the body should be wrapped in a sheet saturated in strong antiseptic solution and buried at least six feet under ground in a situation where it will not contaminate the water supply. Burying in lime is a valuable means of destroying the small-pox virus. Public funerals should be forbidden, and the corpse should not be shipped to distant points, or, where this is done, only under very special precautions for the prevention of the transmission of the disease.

The question of vaccination in order to modify the course of the disease is one of considerable interest, and one about which there is some difference of opinion. If the individual is vaccinated in the first two days after exposure, in most instances, if the vaccination takes, the disease will not develop. The results of vaccination in this period are better where the individual has been previously vaccinated in childhood, and it may be regarded as an almost certain preventive of the disease. A certain number of individuals so vaccinated may contract the disease, and this is apparently due to differences in the susceptibility. Individuals vaccinated before the fifth day, while nearly always protected, will sometimes develop the disease, certainly much more frequently than those vaccinated in the first two days. The protection is greater if the vaccination has been performed previously, as during childhood. Part of the failure to get protection is undoubtedly due to using virus which is no longer virulent, and this may often be avoided by vaccinating three or four times, using different makes of virus. Vaccinations done prior to seven days before the appearance of the eruption of the disease exert a favorable influence on its course, if the disease develops. The malady is apt to be lighter and the mortality less. Vaccinations done during the last seven days of the incubation period exert very little, if any, influence on the course of the disease, and vaccinations done at the appearance of the eruption are absolutely of no value, for, while the vaccination may take, it runs a course independent of the small-pox.

TREATMENT

The treatment of the disease may be divided into: the treatment before the eruption becomes pustular, the treatment during the pustular period, and the treatment during convalescence.

Anything which may make the patient more comfortable will exercise a favorable influence, and so tend to lessen the mortality. Of very great importance is sufficient fresh air. The *ventilation* in the wards should be carefully looked after, and, wherever possible, the *temperature* kept at 68 F. or 70 F., and the air of the room changed frequently by opening the windows. The *bedding* is important because one of the sources of suffer-

ing is the irritation of the bedclothes, and the patients usually complain of sticking pains no matter how well they are looked after. The sheets should be frequently changed, and the mattresses should be as comfortable as can be obtained; and, where suffering is great and it is possible to have one, a water bed is of considerable advantage.

Diet.—The diet is a matter of considerable importance. During the first stage of the disease, if the patient has much fever, there is no appetite, and the diet should be liquid, consisting chiefly of milk, broth, or albumin water. It is a good plan to modify the milk by the addition of carbonated water, barley water, or by partially peptonizing it. Buttermilk may be given if desired, and kumyss and similar preparations often make a desirable change. There is usually intense thirst, and this may be relieved by plain water, lemonade, or the carbonated waters. As soon as the initial fever subsides and the patient feels relieved, it is a good plan to have him take as much nutritious food as possible. The reason for this is that there is always a very great drain on the system in consequence of the extensive suppuration, and, unless great care is taken to anticipate this, the patient is liable to lose weight, often to an alarming degree. During this period milk, eggs, chops, steak, rare roast beef, and the more easily digested vegetables may be given in as large quantities as the patient desires.

As the eruption develops and begins to suppurate there is a second period of fever, and at this time a return to liquid diet must be made. It sometimes happens that only a liquid diet can be given throughout the entire course of the disease, owing to the eruption in the mouth and throat interfering with chewing and swallowing. It is exceedingly important to have the patient take a sufficient amount of food. As a rule, the appetite is gone, the patient objects to swallowing, and it may be very difficult to have the nourishment taken. The food should be given at regular intervals, every two or three hours during the day and every three or four hours at night. If the patient is awake during the night the food may be given at two-hour intervals, in case only small quantities are taken, or at three-hour intervals if larger amounts are taken. An attempt should be made to have the patient take at least three pints of milk, which may be given plain, peptonized, or with the addition of barley gruel or other cereals, or in the form of milk punch. Eggs may be added to the milk, or egg and sherry, or the old-fashioned Stoke's egg and brandy mixture may be used. Broths of various kinds are valuable, and from four to eight ounces of beef juice, pressed from the fresh beef, may be added to the dietary to advantage. This may be given plain or mixed with milk. When there is *dysphagia* the food should be given cold; and in very severe cases rectal feeding may be attempted, although in small-pox it may not be very successful. The use of one grain of orthoform just before taking food is of great service in alleviating the pain

caused by swallowing. Where this does not answer the pharynx may be painted with a one per cent. solution of cocain hydrochlorid just before the meal is given. As a rule, small-pox patients stand the use of cocain very well. This usually permits the patient to swallow with little or no difficulty. In severe cases alcohol may be added to the dietary to great advantage, and it is perhaps best given in the form of whiskey or brandy added to the milk, or with a small amount of glycerin or syrup together with water, so as to avoid the irritating effect on the throat. Milk punch or egg-nog may be serviceable. Port or sherry wine may be used if the patient so desires. As a rule, small-pox patients are greatly benefited by the addition of alcohol, especially in the severer cases. In mild cases and those of moderate severity, under twenty years of age, alcohol is, as a rule, unnecessary.

During convalescence the diet may be increased rapidly, and in the favorable cases there is marked increase in the appetite shortly after the fever subsides. Protein food should be given in great abundance to make up for the loss caused by the suppuration. In cases where the appetite does not return the use of tonics containing strychnia and alcohol is to be advised.

The Throat.—The inflammation in the throat is often the greatest source of suffering, and various demulcent drinks may be given, one of the best of which is flaxseed tea, which has been sweetened and flavored with lemon juice. The mouth and throat require careful attention throughout the disease, and should be thoroughly cleansed with antiseptic solutions, of which 1 to 4,000 permanganate of potash is one of the best; but diluted peroxid or other mouth washes may be used. Chlorate of potash is often of great service. After the mouth has been cleansed the tongue and gums may be swabbed with a mixture of glycerin, boric acid, and water.

Pain.—In the first stage the most prominent symptom is a pain in the back and head. This perhaps is best relieved by the use of antipyrin or acetphenetidin with or without codein sulphate or morphin. Local applications of heat or of counterirritants should, as a rule, be avoided, as a small-pox eruption over irritated surfaces is nearly always confluent. The pain in the head is often relieved by the use of ice bags or by cold applications.

Temperature.—The temperature in the first stage is best relieved by cold pack, cold sponging, or by cool baths. As a rule, the treatment in the first stage presents no special difficulties. The development of the eruption and the changing of the vesicles into pustules bring the patient into the stage in which it is most necessary to take the greatest pains to make him comfortable. At this stage there are numerous things requiring attention. High temperature is best relieved by cold packs or cold sponging. *Cold baths* are frequently recommended, but the difficulty of

placing the patient in and out of the tub renders their use almost impossible.

Suppuration and Delirium.—Where there is much suppuration, or where there is delirium, *warm baths* are of great advantage. In the confluent cases, where there is involvement of the skin to a great extent, a continuous warm bath is one of the best means of treatment at our disposal. The patient is placed in a tub on a sort of cradle, and the water kept at a temperature of about 95 F. The patient in a *continuous warm bath* should have a special attendant all the time, and hot water should be added frequently to maintain the temperature; for if it falls to 90 F. or 92 F. the patient, as a rule, begins to feel chilly and becomes depressed. The effect of the warm bath is to lessen the delirium, when it is present, to keep the patient's skin clean, and to prevent the formation of crusts and scabs, and the subsequent suppuration beneath them. As a rule, continuous baths are employed only in the worst cases, and, while many patients so treated die because of the severity of the disease, undoubtedly many cases are saved by their use.

The treatment of delirium apart from the use of the warm bath consists in the administration of a cathartic, which sometimes acts most favorably in lessening the excitement; and the use of bromids, either alone or with chloral or morphin, is recommended.

Sometimes the delirium is wild, the patient attempting to escape from the nurse to commit suicide or to injure others. In these cases some form of restraint is necessary. A folded sheet or a band of canvas over the chest, and fastened to the sides of the bed, is often all that is needed. Occasionally it may be necessary to fasten the patient's ankles and wrists by broad bands of webbing; but this should not be done unless there is very urgent need for it, as the patient's tugging on the restraint is apt to lead to extensive injury to the skin, inasmuch as the eruption is liable to be very abundant on the wrists and ankles, and the movements of the patient serve to rupture the pustules.

Insomnia.—Insomnia is frequently a troublesome symptom, and may be treated by the use of hypnotics, veronal or trional often acting favorably. One or two large doses of whiskey or brandy may produce sleep.

The Eruption.—The question of the management of the eruption is one of the most important. In the early stages ointments and greasy preparations should be avoided. Wet dressings of various kinds will be found the most satisfactory means of allaying irritation. Dusting powders, while they do much to relieve the local irritation, tend to the formation of crusts under which suppuration is apt to extend. All sorts of things have been suggested; Welch and Schamberg recommend painting the confluent parts with freshly prepared pure tincture of iodine, or in some cases, where this causes irritation, with the tincture diluted. The painting may be repeated every day or every other day. They claim, under

this treatment, to secure an early separation of the scabs and a decidedly lessened tendency to the formation of abscesses, and the inflammation of the skin in the later stages of the disease. A mixture of 25 per cent. alcohol and boric acid is a most useful application; spraying the eruption with alcohol, either alone or with the admixture of other antiseptics, has been advised; the use of sprays of ether and 1 to 3,000 or 1 to 5,000 bichlorid has its advocates; the aim in all cases being to keep the skin clean and to lessen the tendency to infection. When the vesicles or pustules begin to rupture, frequently changed compresses over the worst parts serve to keep the skin clean and to remove the discharging pus, perhaps better than any other method. An effort should be made to prevent the pus from drying and forming crusts, as the skin is liable to become very much inflamed under these, and abscesses form in consequence. When the skin begins to crust in the natural evolution of the disease, ointments may be used to considerable advantage, especially those containing antiseptics, as they tend to lessen the suppuration, to keep the scabs soft, and to favor desquamation. The skin should be bathed in warm water several times a day, as this aids the separation of the scabs. After the scabs have all come away, the skin is frequently tender and easily irritated; and it is then that a dusting powder, talcum, powdered starch, or whatever may be desired should be used frequently. The tender skin may also be hardened by the judicious use of alcohol rubs or alum baths. *Erysipelas* occasionally develops, and is best treated by wet dressings of antiseptics; bed sores may be treated in the usual manner; and it occasionally happens that gangrene of the skin may be met with. *Abscesses* should be opened as soon as suppuration is evident, and the opening so placed as to favor free drainage.

Itching is a symptom which causes great discomfort, and as far as possible should be controlled, as it leads to insomnia, increases the nervousness of the patient, and leads to scratching, which tears the vesicles or pustules open, and so renders infections of the skin much more frequent. Various external applications have been suggested for the relief of itching. Spraying with alcohol, with or without the addition of $\frac{1}{2}$ to 1 per cent. menthol, is of value; sponging with carbolic acid and water, 1 to 40, is efficient in many cases; or the carbolic acid may be applied in the form of an ointment. Salicylic acid is applied either in solution or as an ointment, and ichthyol is an efficient application either as an ointment or diluted with glycerin. During the early stages of the disease ointments are, as a rule, best avoided, although there are times when they may be most useful. Alum baths, 1 to 5 per cent., are of considerable service, and various antiseptics have been recommended, chief of which is bichlorid of mercury, but these are uncertain in their antipyretic action. Dusting powders are of great value in allaying itching, but, as a rule, should not be employed until the last stages of the disease (v. supra).

The scarring is lessened by anything which prevents suppuration, and everything which one can think of has been tried. The application of the tincture of iodine as suggested by Welch and Schamberg is, perhaps, more effective than any other method. Puncturing the pustules is of little or no value, and most of the other methods in vogue are extremely questionable. There is a prevalent idea that, if the scabs are softened and removed early, the scarring will be less. Welch and Schamberg suggest the use of an ointment containing two drams of sodium bicarbonate in one ounce of petrolatum as being the most efficient preparation they have found for this purpose. Frequent baths help more than anything else, and the baths should have some antiseptic added, as bichlorid of mercury, 1 to 10,000 or 1 to 20,000, or alum, 1 pound to a tub of water of 450 to 500 liters, or about 1 to 1,000 solution.

The *odor* from small-pox patients is particularly objectionable, and adds considerably to the discomfort of the patient and greatly to that of those about him. It is best controlled by very frequent baths, to which has been added potassium permanganate.

The Eyes.—Of very great importance are the complications affecting the eyes. If the eyes are only moderately inflamed, the frequent use of a boric acid eye wash, and the use of some mild antiseptic ointment to the edges of the lids to prevent their sticking together, are all that is needed. The use of this ointment is of primary importance, as the lids frequently get stuck together, and the pus, finding no outlet, causes pressure upon the cornea, often with rapid ulceration, which may result in the loss of sight or of the entire eyeball. Welch and Schamberg advise the use of nitrate of silver applied to the mucous membrane in cases where there is much swelling or discharge. A five per cent. protargol solution may be employed instead. Where there is much swelling and chemosis it is important that an outlet be made for the pus. The authors mentioned advise the use of cuts in the conjunctiva, or even cutting the outer canthus, if it is necessary, to enable the physician to inspect the cornea and to provide for free egress of the pus. If the cornea becomes ulcerated, and it frequently does, atropin should be instilled when the ulceration is central, in addition to the frequent flushing with the boric acid eye wash. The flushing should be used very often and the external application of cold employed in the intervals. If the ulceration is about the periphery eserine sulphate, gr. $\frac{1}{4}$ to the ounce, should be cautiously employed. As soon as the pupil is contracted the eserine should be stopped. If rupture of the cornea threatens, the edges of the ulcer should be cauterized, using a very dull red cautery or trichloroacetic acid. The use of ointments in the eye is important to prevent the denuded cornea from forming adhesions; and those containing small amounts of yellow oxide of mercury are most frequently employed. Ointments of this drug containing, in addition, small amounts of atropin are of great service in treating the

milder degrees of ulceration of the cornea. The treatment of the eye conditions must be carried on both day and night, as in many instances neglect is promptly followed by loss of sight.

Inflammation of the Larynx.—Inflammation of the larynx is a less frequent complication, but one which leads to great suffering. Inhalations, either from lime water or from a dram of compound tincture of benzoin in a pint of water, will be found useful. Menthol may sometimes be added to the latter with advantage.

Edema of the Glottis.—If edema of the glottis comes on the patient is apt to die of suffocation unless tracheotomy is done. But, with the tissues of the neck swollen, tracheotomy may be an operation extremely difficult to perform, and attended by considerable hemorrhage. Inflammation of the tongue is not infrequent. The tongue should be painted with glycerite of tannic acid, and, if the swelling becomes very great, incision may be necessary. The other complications are treated along general lines, and scarcely require special mention.

Red Light Treatment.—This has been in use ever since the time of John of Gaddesden, who suggested the use of red bed clothing, red bed curtains, gargling of the throat with mulberry wine, and the sucking of red pomegranates.

In more recent times red light has been employed extensively, the actinic rays of the skin being excluded by using red glass or red cloth. Würtzen has called attention to the fact that the glass should be tested with a spectroscope to see that it does not admit of the passage of green rays, as much of the red glass on the market deteriorates rapidly and is not very effective; the color of the glass to the naked eye not being a sufficient test. As a rule, the red light is well borne by the patient, but nurses and attendants often find it trying. This is somewhat alleviated by wearing variously colored glasses chosen according to individual preference. There has been a general impression that the exclusion of the actinic rays lessens the amount of the eruption, and particularly lessens the amount of suppuration and the subsequent scarring. Whether or not the red light possesses any therapeutic value should be carefully tested. The most recent reports upon the subject would seem to show that it exerts no influence one way or the other upon the course of the disease.

Potassium Permanganate Treatment.—In place of the red light bandages saturated with potassium permanganate have been suggested. These are changed three or four times a day for the first few days, until the skin is well discolored by them, and later less frequently. There is a great difference of opinion concerning the value of this method, but it has its enthusiastic advocates, among whom may be mentioned Dreyer, who claims to have obtained satisfactory results from it. In his cases he believed that the amount of suppuration was less; that the patient

was more comfortable, and that there was less odor than with the other methods of treatment.

Serum Treatment.—The injection of the serum from a previously vaccinated heifer has been suggested, based upon the fact that, if this serum is used in another heifer, it produces a certain amount of immunity against vaccination. This method of treatment has not been tried in a sufficient number of cases to allow one to give any opinion in the matter. Kinyoun claims to have obtained good results from it.

Injecting serum from persons who have had an attack of small-pox has also been suggested. The amount of serum obtainable has been small and the results up to date negative. The method is not to be recommended in the present state of our knowledge.

SMALL-POX INOCULATION

Small-pox inoculation has been known from very early times, as it was practiced centuries ago in China; the method used by the Chinese being to stuff the dried small-pox scabs into the nostrils. Inoculation was also practiced in India and by various oriental races, particularly by the Turks. The first communication on the subject in England was made in a communication to the Royal Society by Dr. Woodward about 1711. He reported the work of Emanuel Timoni, which was subsequently reported before the Royal Society by Pylarini, Russell, and others. It was described by Kennedy in an "Essay on External Remedies," London, 1715, but no particular attention was paid to these communications. The real introduction of inoculation into England was by Lady Mary Wortly Montague, the wife of the Turkish Ambassador.

The method is exceedingly simple and consists of inoculating, usually at the insertion of the deltoid, a small amount of the small-pox virus, generally secured from a vesicle on about the fifth day of its development, although the virus is active if taken at a later period. The poek develops rapidly, minute changes being present as early as the second day. The patient is conscious of the inoculation on the third or fourth day, and there is a small hard nodule surmounted by a vesicle on the following day. The vesicle is well developed on the sixth day and there are considerable inflammation and some pain and tenderness. On the seventh or eighth day there are usually a chill or chills, headache, vomiting, and fever. The inflammatory changes in the arm begin to subside at this time, and there is an irregular area covered with vesicles, and there may be a few vesicles on other parts of the body. Sometimes there are only two or three of these, while in other instances there may be a number, one or two hundred or more. Occasionally a very severe type of the disease is produced, but, with reasonable care, the disease runs a mild course

and the mortality has been estimated at about $1/5$ of 1 per cent. While this is a rather crude method of obtaining immunity, it is attended with no danger as compared to that from small-pox acquired in the ordinary way, and, while it has been superseded, and very properly so, by vaccination, circumstances might arise to render this method a proper procedure, such as a small-pox epidemic in the absence of any vaccine virus. As ordinarily practiced, children were inoculated, and the chief objection that can be urged is that a person so inoculated is capable of spreading the disease just the same as one who has taken it by ordinary methods.

CHAPTER IV

VACCINATION

JOHN RUIRÄH

Vaccination may be described as the production of an immunity for small-pox in man by inoculation with the virus of vaccinia or cowpox. This inoculation is characterized by the production of one or more papules which change into vesicles, become umbilicated, pass into a pustular stage, and finally dry up with the separation of the scab, leaving behind a rather typical scar. Accompanying this are symptoms of a constitutional nature, chief of which are fever and more or less malaise.

To correctly understand the importance of vaccination and the great benefit which it has conferred upon the human race, it is necessary to bear in mind that, prior to the beginning of the nineteenth century, small-pox was the most widely disseminated and most dreaded disease. The number of deaths caused by the disease was appalling. The population of all countries was made up of individuals who had had the disease, usually in childhood, and who had survived it. Occasionally individuals would not take the disease until late in life, but in a general way the disease was regarded much in the light in which we now regard measles, a disease which almost every one had before seven years of age.

It was estimated by Bernouilli, writing about 1760, that small-pox carried off the thirteenth or fourteenth part of each generation.

The disease was present in all countries practically all the time; but from time to time devastating epidemics would sweep the various continents, leaving in their wake not only the tremendous number of deaths, but a population with scarred faces, blind eyes, and numerous other serious affections.

The Pock Diseases of Animals.—These diseases bear a very close relation to vaccinia, and, taken altogether with the various changes brought about by inoculation into various animals, form one of the most curious chapters in the natural history of disease. These diseases may be divided into two groups. The first, occurring in epidemic form and also sporadically, is very easily communicated from one animal to the other, the contagious principle traveling apparently through the air; although

I believe a careful study will reveal that this transmission through air is more apparent than real, the transmission in such cases taking place through infected dust and infected particles of skin, saliva, etc. A second characteristic of this group is that these diseases are, for the most part, very fatal; and a third common characteristic is that the eruption is general. This group includes small-pox, as it occurs in man, sheep-pox or ovina, and chicken-pox. The second group practically never occurs in epidemics, is due to an accidental or intentional inoculation, the virus from the eruption being definitely transmitted in a known manner into an abrasion of the skin, at which point it causes a local eruption, usually one or more pocks; and these diseases are rarely fatal. This group includes vaccinia or cowpox, horsepox, and several other pock diseases, the nature of which is not very well understood, owing to the fact that opportunities for their study are rarely afforded. These include the pock disease of camels, of goats, and of monkeys; and it is quite probable that in all three of these instances we are dealing with one of the above diseases that has been inoculated into the animal in question.

SHEEP-POX.—Sheep-pox occurs as an epidemic disease, the incubation of which is from eight to ten days. It is characterized by a general eruption and by constitutional symptoms, and it is attended by a very high mortality, from 25 to 50 per cent. If the virus from this disease is transmitted to healthy sheep by inoculation, a milder disease is produced, the incubation period of which varies from four to eight days, and when the sheep recovers it is immune; but unfortunately this method of protection is attended with a too great mortality to be of any service. Sheep-pox is not ordinarily a cause of death in man, and it is only with difficulty that it may be transferred to man by inoculation. When it has been transferred, as in the experiments of Sacco, it was found that it produced a local eruption which could not be told from ordinary vaccinia, and which afforded protection against small-pox. The difficulty of securing a successful inoculation and its tendency to spread in epidemics among sheep prevent its being used in producing immunity for small-pox in the human being. The disease may be transmitted to other animals, to cattle and to rabbits. If the virus from a vesicle in man, or from a cow, or from a rabbit, is reinoculated into healthy sheep, this retro-inoculation is usually successful, produces only a local sore, and protects the sheep against sheep-pox. Sheep-pox may be transmitted to goats, and it is then usually called goat-pox. The virus obtained from goats has been used in the past to secure immunity against small-pox in man, but comparatively little is definitely known about this subject. The sheep is not ordinarily susceptible to human small-pox.

HORSEPOX.—This is a local disease transmitted from one animal to another by inoculation. It is apt to occur as a local eruption about the fetlock joint of the hind legs, perhaps due to the frequent injury of this

part of the body. Sometimes it produces a more or less widespread eruption from autoinoculation; and a general eruption may be produced by injecting the virus into the veins or lymphatics of colts. The disease may be transmitted to cows, in which case it is usually carried by the milker, who has previously dressed the sores on the horse. Jenner thought that cowpox was derived from horsepox, but this is questionable. Both human small-pox and cowpox, if inoculated into the horse, are capable of causing lesions which it is difficult or impossible to distinguish from the ordinary natural horsepox. Inoculated into man, it produces vesicles that resemble the vesicles of vaccinia, and it protects from small-pox, as has been proved by the experiments of Sacco and also of Loy. The pock disease of camels mentioned above may be transmitted to man, usually accidentally, as on the hands of milkers; and individuals so affected are said to be protected from small-pox.

APPE-POX.—Monkeys are susceptible to small-pox, and during epidemics in the tropics they have been known to take the disease naturally. They may be vaccinated with cowpox, and an immunity produced in this way. When the small-pox lymph is inoculated into monkeys, it usually causes only a local sore, but sometimes this is accompanied by a general eruption.

COWPOX.—The most important of all the pock diseases of animals, however, is the cowpox or vaccinia. This is seen as a result of inoculation of the virus of the disease from one animal to another, and it occasionally occurs without any such apparent inoculation. This latter is designated as natural cowpox. Natural cowpox apparently never has been a very common disease, and it is much rarer now than formerly, so much so, indeed, that a single case of it is recorded in the literature and is regarded as a matter of great interest. It is a disease which is more apt to be seen in the spring or early summer, at the time when there is the greatest flow of milk, and it almost always affects cows, but it has been observed both in calves and in bulls. When it starts in a herd, it spreads rapidly, usually being transmitted by means of the hands of the milkers. The cow may have fever and loss of appetite before the appearance of the eruption on the skin, or the eruption may be the first thing noted. There is a slight difference between the eruption in the natural cowpox and the inoculated variety. In the former the eruption comes out in crops, so that the various stages of the eruption may be noted on the udders at the same time, just as in human chicken-pox the eruption comes out in successive crops. In the inoculated cowpox, however, all of the papules start at the same time and run through their course in about the same manner. The udder becomes swollen and painful, and there are small red papules present, which vary in size from $\frac{1}{2}$ to 2 to 3 cm. Vesicles appear on these and they become multilocular. They may or may not be umbilicated. In about a week the clear lymph has changed

to pus, and on about the twelfth day the eruption begins to dry up. During the pustular stage there are usually constitutional symptoms, chief of which is fever. There may be slight variations in the course of the disease, and considerable variation in the appearance of the eruption due to secondary infections, which sometimes produce marked ulceration. The scabs usually separate between the eighteenth and twenty-first day and leave behind typical scars. One attack confers immunity which apparently lasts as long as the cow lives. The immunity produced in man differs from this, in that it gradually becomes weaker and may wear off, so that the individual becomes susceptible to small-pox and also to cow-pox; and a subsequent vaccination may produce a second sore and a second immunity. This varies considerably in different individuals.

Cowpox is easily transmitted to man, and when this is accidentally done the inoculation is usually upon the hands of those milking the cows. Inoculated into animals it produces a local sore. In passing through some animals it seems to gain in virulence, for example, in the rabbit, a lymph which is losing its virulence, will usually regain it. In sheep, it produces a general eruption, and the disease may become highly contagious for other sheep and occur in epidemic form so that cowpox inoculation cannot be used to protect sheep from sheep-pox.

History of Vaccination.—The history of vaccination dates back to the traditions that have been handed down in almost all countries, in various parts of Asia and Europe and in Mexico, that individuals who have been affected by cowpox or the other pock diseases of animals have been regarded as immune to small-pox. There are vague traditions that the disease has been purposely transmitted to man with the idea of producing immunity. Individuals having immunity to small-pox by reason of their having had an accidental inoculation have at various times been subjected to inoculations, the first of which is probably that of Sutton and Fewster, who, in England in 1788, inoculated such an individual with small-pox, the inoculation being unsuccessful. Heim relates that he was told by his father, in 1763, that individuals who had had cowpox were not susceptible to small-pox. Bose, in 1769, also noted this fact.

The first undoubted record of the cowpox virus being inoculated into man to prevent small-pox was the vaccination done in 1774 by Benjamin Jesty, a farmer living at Yetminster, in Dorset. He vaccinated his wife and two sons. Platt, a German school teacher living near Kiel, in 1791 vaccinated some individuals in a similar manner; and there were various other sporadic experiments which need not be noted.

To Jenner belongs the credit of having thoroughly studied the question of immunity as it relates to cowpox and small-pox; and of having collected and published data and the records of his experiments; so that, due to his publication, vaccination rapidly became a world-wide procedure. There were many other workers in the field, too numerous to men-

tion; but one cannot pass over without noting the work of Sacco (25), the Italian observer, who, next to Jenner, did more to promote our knowledge of vaccination, and consequently its use, than any one else. There is some difference of opinion as to when Jenner started his observations upon cowpox, but it was probably not until about 1778 that his attention became especially turned to this subject.

Jenner was apprenticed at a very early age to Messrs. Ludloy, practitioners at Sudbury, near Bristol, and he remained with them six years. It was during this period, according to Baron, that the famous milk-maid incident occurred. A young countrywoman came to seek advice; and the subject of small-pox was mentioned in her presence. She is said to have observed, "I cannot take that disease, for I have had cowpox." In 1778 he inoculated a certain Mrs. H. with small-pox virus and this was unsuccessful, a result which he attributed to her having previously had cowpox. From that time on he studied all the cases that he could find. In 1780 there is a record of a conversation which he had with his friend Edward Gardner, in which he explained the subject of the protection afforded against small-pox. In 1788 he took a drawing of the hand of a milker with cowpox to London, where it was shown to various members of the profession. The subject of cowpox became more or less talked about, and was the subject of conversation and lectures; and various references occurred in the medical publications. Jenner collected 16 cases in which individuals who had had accidental inoculations with cowpox were subsequently inoculated with small-pox, and all unsuccessfully. In 1796 an opportunity was presented, owing to the development of a cowpox vesicle on the hand of a dairy maid, Sarah Nelmes by name; and, on May 14, Jenner vaccinated James Phipps, a healthy boy of eight years of age, using a method similar to that used in the inoculation of small-pox. The vaccination ran a typical course, and six weeks later Jenner inoculated him with small-pox, but without success. In 1796 or 1797 Jenner sent a manuscript containing the results of his work to a friend who was in close connection with the president of the Royal Society, but he received the friendly advice not to publish the paper in the Transactions for fear of injuring his reputation. He therefore resolved to publish the article himself, which he did in 1798 under the title of "An Inquiry into the Causes and Effects of Variola Vaccinæ, a Disease Discovered in Some of the Western Counties in England, Particularly Gloucestershire, and Known by the Name of Cowpox" (17a). The publication of this paper brought forth a host of unfavorable criticisms, the most important of which were those of Dr. Ingenhousz, who opposed Jenner's ideas. The opposition at this time to vaccination was marked, and Jenner's statements were the subject of considerable ridicule. In the meantime his vaccine lymph, which had been transmitted through some five generations, had been lost. He

succeeded, however, in again obtaining the cowpox virus and vaccinated others with it. Some of the medical men and scientists were interested in proving or disproving Jenner's theory, among whom may be mentioned Pearson (21) and Woodville (27), who inoculated over 160 individuals with cowpox. Over 60 of these were afterward inoculated with small-pox, but none took the infection. In March, 1799, Pearson sent a letter in which he inclosed an infected thread to some 200 practitioners with the request that they try its effects and report their results. He also sent the virus to Paris, Berlin, Vienna, Geneva, Hanover, and to Portugal. This is not the place to go into the details of the discussion which took place at that time. Suffice it to say that Jenner published, in 1799, "Further Observations on Variola Vaccinæ, or Cowpox" (17b), and, in 1800, "A Continuation of Facts and Observations Relating to Variola Vaccinæ" (18a), and, in 1801, "The Origin of Vaccine Inoculation" (18b). In 1799 a public vaccine institute was started by the friends of vaccination, and Pearson was placed in charge of this. A few years later, in 1803, a Royal Institute for the extermination of small-pox was founded, and Jenner was placed at the head of it; a position which he retained for many years. Both of these institutes did a great work in spreading the propaganda of the prevention of small-pox. There was always more or less opposition to vaccination in England, and this was based on various grounds, perhaps chiefly because it was an encroachment on the rights of the individual. There were also objections of a more political nature raised in England; and more particularly in other countries some of the opposition was placed on religious grounds. The danger of transmitting syphilis also furnished a fruitful source of objection which was eventually overcome by the use of virus obtained from animals. There were numerous attempts to secure a vaccination law, but the opponents always succeeded in preventing its passage; and, in spite of numerous severe epidemics, a law was not passed until 1867. In 1855 the General Board of Health sent to 542 authorities in various parts of the world and secured replies from all of them on the efficiency of vaccination and its possible dangers. The results of this investigation were published in 1857, in the Blue Book on Vaccination, which still remains one of the greatest monuments to Jenner, as well as one of the most complete collections of facts concerning vaccination that we have. The efficiency of the English law has been impaired by the introduction of the conscience clause, which allows a person to object if he has conscientious scruples against vaccination. The progress in Ireland and Scotland was also slow. A compulsory law was passed in Scotland in 1864.

The early history of vaccination in various countries forms an interesting chapter in the history of medicine, but we can only mention a very few facts in connection with it. Next to the work of Jenner is that of Luigi Sacco (25), of Milan, who became a great friend of Jenner and

started a vaccine institute, and did much toward spreading the practice of vaccination. No law has ever been passed in Italy making vaccination compulsory, but it has been fairly generally practiced. Following out the suggestions of Galbiati and Feola, Negri succeeded in elaborating the method of using animal virus in 1849; and this method has very largely supplanted the use of human virus in most countries. It is very frequently referred to as the Neapolitan method.

In France the first vaccinations were done by Valentin and Desoteux, and this method of preventing small-pox was greatly spread by Aubert and Huisson. In 1805 Napoleon had those of his soldiers who had not had small-pox vaccinated; and in 1809 the first decree in favor of vaccination was issued. Vaccination was never very popular, however, and was only imperfectly done, although considerable interest from a scientific standpoint has always been manifest. The report of the Commission of Lyons in 1865 and the subsequent publications of Chauveau are among the best-known articles. France paid dearly for neglect of vaccination in the Franco-Prussian War as noted below under the heading of Germany.

Vaccination was introduced into Spain and Portugal about 1800 and has been practiced to a greater or less extent, although there are no compulsory laws dealing with the subject.

In Austria the subject was taken up by Ferro and spread particularly through the efforts of de Carro, who vaccinated large numbers of individuals and circulated pamphlets and vaccine lymph at his own expense. In 1801 he secured official recognition for it, and the Imperial and Royal Institute for foundlings was made the Vaccine Institute.

In Switzerland it was introduced by Odier. Vaccination was introduced early into Russia and vaccine institutes were founded in the largest cities; and the better classes have always availed themselves of this means of protection. As a country, Russia is rather poorly vaccinated; perhaps less since the abolition of serfdom, as the care of the landlord has been removed from the very lowest classes.

Vaccination has been practiced in Holland and Belgium, although there is no special legislation on the subject. It was introduced into Sweden in 1801, and, shortly after, a compulsory law was passed. In Norway and Denmark special decrees in favor of vaccination were issued in 1810, and, while these did not make vaccination compulsory, the interest taken almost amounted to a law.

The most satisfactory and interesting results have been obtained in Germany. Vaccination was introduced into the various German states; and in 1802 there was a public vaccine institution started in Berlin and shortly after in other cities.

In Prussia there was no law until 1816, when a law requiring that

school children be vaccinated was passed; a law similar to one that had been adopted in Austria.

The first satisfactory compulsory vaccination law was passed in Bavaria in 1807, due to the influence of Reiter. This provided that all infants be vaccinated in their first year of life. The enforcement of this law resulted in small-pox becoming exceedingly rare in Bavaria.

In 1870 one of the worst epidemics of small-pox of recent times started and spread throughout Europe, largely owing to the movements of troops. This epidemic did not cease until after 1873, when peace had again restored the normal quiet. The Germans were fairly well vaccinated, for, while there was no revaccination law, those entering the army were always vaccinated; while in France vaccination was very poorly practiced, and, as a result, there were not only more cases in the French army, but they were of a more malignant type; and the mortality was very much greater in France. The absolute mortality was fifty times greater than in Germany; and the ratio of deaths to the number of cases nearly twice as great. Shortly after the formation of the German Empire the German vaccination law was passed, in 1874. This law provides that all infants must be vaccinated during the first year of life unless the infant has had small-pox during that period. If, for any reason, vaccination should be regarded as a dangerous procedure, owing to the ill health of the infant, it must be vaccinated within one year after its recovery from any such condition. Revaccination must be practiced when the child is twelve years of age, if in a public school, unless it has had small-pox during the past five years. If this vaccination is not successful it must be repeated the next year. There are special vaccine physicians provided for, so that vaccination may be had without cost, and the law provides that the individual vaccinated must return not earlier than the sixth nor later than the eighth day to the physician who vaccinated him in order that the result may be determined. Records of all vaccinations and the results must be kept by the physicians doing the vaccinations, and sent to the authorities at stated intervals. In addition to this the parents or guardian must obtain certificates of vaccination for all children under their care, and these are to be furnished when demanded by the authorities. The German law has not been passed or enforced without a certain amount of opposition; but so far the opponents have always been outvoted in the Reichstag. As a result of this thorough vaccination, Germany has had no epidemic since 1875; and there have been scarcely any cases of small-pox in Germany except those cases which have been imported from neighboring countries where vaccination is not practiced to such an extent.

In America inoculation was practiced particularly in New England, and Dr. Benjamin Waterhouse, of Boston, was particularly active in the prevention of small-pox. It was very natural that he should become

interested in vaccination. In 1799 he wrote an article which was published in the *Columbian Sentinel* of March 12 entitled "Something Curious in the Medical Line." In July, 1800, after having secured some virus from England, he vaccinated his son and subsequently a servant boy 12 years of age, and an infant, and its nurse. These individuals were subsequently exposed to small-pox and also inoculated, but with negative results. There was considerable opposition to vaccination in the United States, but the practice spread rapidly, although compulsory laws were not passed, as a rule, until comparatively recent times. President Jefferson took a keen interest in the subject and had his family vaccinated with the virus, which he secured from Waterhouse. It was from this stock that the District of Columbia and a great many of the states were supplied with vaccine virus, and Jefferson took great personal interest in seeing that instructions as to the time of taking the lymph and its use were sent with it. The practice of vaccination in the United States varies greatly in the different states, and the compulsory laws that exist have usually been the result of an epidemic; as, for example, in the case of Baltimore, where it was not until there had been several thousand cases and a very large number of deaths that a compulsory vaccination law was finally passed, which provided for the vaccination of all individuals, although the only inspection provided under ordinary circumstances is to see that the children are vaccinated when they enter school.

The Preparation of Vaccine Virus.—Vaccine virus may be obtained in several different ways. The older method was to use humanized virus; and the lymph was taken direct from the vaccine vesicle and transferred to the arm of the person about to be vaccinated. It was the simplicity of this method which permitted the rapid spread of vaccination at the time when it was first introduced. If it was desired to preserve the virus this was done by drying it on threads, ivory, or bone points. In more recent times it has been drawn into capillary tubes or into small bulbs, usually with the admixture of equal parts of glycerin. The lymph should be taken preferably on the eighth day, although it may be taken a day earlier. It is not a good plan to use the lymph after it has become purulent. This method has practically fallen into disuse with the exception of a few individual practitioners who continue to use it; and a few countries, of which may be mentioned Mexico, where it is said the human lymph is still preferred. In Germany the law prohibits the use of any except animal lymph, but it is probable that in the other European countries more or less human lymph is used and marketed. In collecting the lymph from the vesicle, radiating scarifications should be made, and the lymph taken up on the end of a lancet or in capillary tubes or bulbs. Sometimes it is taken upon clean glass slides and allowed to dry between two pieces. The advocates of the humanized lymph argue that the virus

is less apt to be contaminated with bacteria, that it is more certain to take, especially when transferred directly from arm to arm, and that it is less expensive. There are other advantages urged which need scarcely be mentioned. The objections to it are the possible dangers of transmitting syphilis and other diseases; and, while the transmission of syphilis is a real danger, the disease is probably not caused in this way as often as was thought, as the vaccination of an infant with hereditary syphilis often causes the syphilitic eruption to appear at the site of the vaccination. The fact that the transference may occur, however, is sufficient ground to exclude humanized lymph from ordinary use. The danger of the transmission of tuberculosis, leprosy, and other diseases is a negligible quantity. For the use of animal lymph we are indebted to the Italian observers. For the most part members of the bovine family are used, although other animals may at times be substituted, the rabbit having a number of advocates.

The technique of preparing the vaccine virus consists, first, in having the proper seed. There has been in the past more or less contention, particularly by the antivaccinationists, that the seed vaccine was not uniform, that there was a possibility of its being horsepox instead of cowpox, and that it was also probable that small-pox inoculated into animals and transferred for several generations was used. This question is of comparatively little importance, as it has been definitely proven that the vaccine virus used at the present day is capable of conferring the immunity which is desired, and the remote origin of the various strains of vaccine virus is only of academic interest.

The method here described is that used in the National Vaccine and Antitoxin Institute of Washington, D. C., but practically the same technique is used by the various firms interested in the production of vaccine virus; and in the United States this is done under rules which have been formulated by the U. S. Public Health and Marine Hospital Service. The chief variations will be noted. Country-bred heifer calves of from six to ten weeks of age are chosen, the heifers being preferred because they are more cleanly; and the young calves because they are more susceptible to the vaccine, and because they are less likely to develop tuberculosis. The animals are placed in a quarantine stable, the temperature is taken night and morning, and they are carefully inspected each day by a competent veterinarian. This period of quarantine lasts for seven days, and the vaccination is usually made on the seventh day. Some producers of vaccine virus test the calves to be used with tuberculin, but this procedure is often not carried out, owing to the fact that tuberculosis rarely develops in calves as young as those used, and, if it should, it would be discovered at the post-mortem examination which is held on every animal immediately after the vaccine pulp has been removed. The danger of transmitting tuberculosis from a calf by means of vaccine

virus is so remote as not to need serious consideration. Each calf is given an identifying number which becomes the laboratory number of the vaccine obtained from it, and appears upon each separate package of vaccine; and under this number there is a permanent record of the history of the animal, the kind of seed used, and the notes of all the veterinary and laboratory observations made in connection with it. A record is also kept of when the virus is shipped and to whom. After the animals have passed quarantine they are at once prepared for inoculation by carefully shaving the hair from the entire surface of the abdomen and scrubbing the calf thoroughly with green soap. Some antiseptic solution is then applied, which is subsequently washed off with sterile water. The calf is taken to the operating room, which is built after the manner of a modern operating room, with walls and floors of concrete and the furniture of white metal and glass. The whole room is kept scrupulously clean, the walls and furniture frequently washed with bichlorid solution. The operators work in clean white suits and every precaution is taken to render the operation as aseptic as possible. The inoculations are carried out by making a long superficial incision down the whole length of the abdomen, with cross incisions of one inch. The seed vaccine is thoroughly rubbed into these and then the animal is removed to the incubating room, which is kept at a uniform temperature of 70° F., and is darkened by drawn shades. The animals are fed only with pasteurized milk and are kept as clean as possible. On the sixth day, which is somewhat earlier than the time used for taking human lymph, as the vesicle develops more rapidly in the calf than in man, the animal is again removed to the operating room and the pulp removed, with the same aseptic precautions as had been used in making the inoculations. The lymph and pulp are gathered together by lightly curetting the vaccinated surface. In former days the lymph only was used, but it was found that the pulp, which consists of the remaining portions of the vaccine vesicle, contained more of the active principle than did the lymph, and that both together could be used to great advantage. This is placed in sterile vessels and removed to the laboratory, where it is thoroughly mixed with a solution of 50 per cent. glycerin and 50 per cent. normal salt solution. The mixture is then placed in a refrigerator and allowed to remain there for three or four weeks. At the end of that time samples are taken, and plate cultures made and incubated, each plate representing the quantity used in one vaccine point. Lymphs at this period vary, some showing several hundred colonies of bacteria to the vaccination, and others showing many times that number. The lesions of this primary test are recorded, and if the bacterial count is low another count is made in a week's time. This is continued until the lymph does not show over fifteen or twenty colonies of foreign bacteria to the vaccination. Occasionally the lymph shows no foreign growth whatever, so that it may be

put out within a short time, as early as six weeks, with none or almost no colonies of bacteria to the vaccination. When the count is sufficiently low, the different cultures of bacteria are examined microscopically and a portion of the lymph is inoculated into fermentation tubes. At the end of 72 hours 2 c. c. of the bouillon culture is withdrawn from the fermentation tube and injected subcutaneously into guinea pigs. The absence of gas or anaerobic growth in the fermentation tube at the end of 72 hours, negative results from the injected guinea pigs, and negative results from the microscopic examination are all necessary before the lymph is finally passed. Sometimes the lymph is discarded, owing to the presence of the colon bacillus or other gas-producing organism. In former years the calf was kept from eight to ten days after the lymph was taken, but in no instance did a calf develop tetanus. If the post-mortem examination, which is made immediately after the vaccine pulp is taken, shows infected lymph nodes or lesions of any of the organs, the lymph and pulp are rejected. Everything used about the inoculation is thoroughly sterilized with a sterilization which is sufficient to kill the tetanus organism. Everything that can be is sterilized in an autoclave. The ivory points are sterilized by means of fractional steaming. The finished points and tubes are frequently subjected to examination by means of cultures, and it has been shown that there is no contamination in charging the points or filling the tubes.

Just as human vaccine virus occasionally runs out without any apparent reason, it so happens that in the calf it will do the same, so that the vaccine seed is transferred to rabbits from time to time, and this procedure seems to increase the virulence of the vaccine virus.

The diluent for the virus varies in different makes, but almost all substances used for this purpose have been discarded in favor of 50 per cent. glycerin, which has been shown not only not to interfere with the preservation of the virus, but to lessen the number of foreign bacteria, especially when kept in a cold place; and it also prevents the possibility of the growth of the tetanus bacillus. The virus so preserved will keep perfectly well if kept cold; the temperature preferred is below 0° C. rather than above. At -10° C. the virus is almost perfectly preserved, and the lowest temperature which is necessary to kill the virus has never been determined. It even withstands the low temperature produced by liquid air. The virus is rapidly affected by heat, and exposure to 60° C. is sufficient to kill it. Virus will rapidly deteriorate at room temperature, and it takes comparatively short exposure at 21° C. (70° F.) to render the virus useless.

The Florida State Board of Health issue the following instructions in regard to the preservation of vaccine virus:

Vaccine should be kept on ice until used.

Vaccine not kept at a low temperature soon becomes inert and will not "take."

Dr. Elgin found that:

Vaccine kept at 140 deg. F. 5 minutes was dead.

Vaccine kept at 132 deg. F. 5 minutes was weakened.

Vaccine kept at 98 degrees F. 3 to 4 days was dead. (This is body temperature and about the temperature at which the vaccine would be kept if carried in the pocket.)

Vaccine kept at 70 deg. F. 1 to 3 weeks was weakened but not dead.

Vaccine kept at 50 deg. F. 3 to 6 months was still active. (This is about refrigerator temperature.)

Vaccine kept at 10 deg. F. 4 years was still active.

The lesson is:

Keep vaccine in the refrigerator until used.

Don't use vaccine that has not been kept at low temperature and expect to get "takes."

It has been thought that the failure to take has been due to acidity, but a Committee of the Standard Methods of Preparing Small-Pox Vaccine of the American Public Health Association found that an acidity of from $\frac{1}{2}$ to 1 per cent. and an alkalinity of $\frac{1}{4}$ to 1 per cent. are unimportant. The degree of dilution varies somewhat; ordinarily diluted in the proportion of 1 to 8 has been found to be a dilution which practically always takes if everything else is all right; and, while very great dilutions will sometimes take as a matter of experiment, they are not suitable for ordinary practical purposes. Lanolin has been suggested and is sometimes used in hot climates, but it is more difficult to get a uniform distribution of the pulp than from the use of glycerin. The test for the bacterial contamination and particularly for the tetanus bacillus is not uniform, and there is still some question as to what should constitute a proper test for the detection of tetanus germs. As a matter of fact the tetanus bacilli have been discovered in vaccine virus with very great rarity, but two observers, as far as I know, having ever demonstrated them. The danger of tetanus from the vaccine virus issued from a laboratory using the methods customary in this country is so slight that it need not be considered. Various antiseptic solutions have been suggested, such as chloreto-ne, sodium baborate, boracic acid, toluol, potassium cyanid, phenol, and chloroform vapor. The addition of 1 per cent. phenol in glycerin has been suggested. It apparently does not interfere with the efficiency of the virus in the three months' period which is usually allotted. The English laboratories suggested drawing chloroform vapor through the emulsion of pulp and virus. Other methods have been at times suggested. The one outlined above is satisfactory, and the only advantage of the others is the possibility that the lymph may be put out

more quickly, but it seems quite probable that the addition of these antiseptics would eventually affect the virus rather markedly.

RABBIT VIRUS.—Various observers have suggested the rabbit as being an animal which will produce a very pure and active virus. A delicate haired rabbit is chosen, the hair clipped off of a large area on the side and abdomen, and then closely shaven and scarified. The virus is then rubbed on and the animal kept in a germ-free cage with a raised wire floor through which excretions may pass. The animal is given a thoroughly cleaned carrot each day and on the fourth day the animal is killed by chloroform. The whole animal is wet with 5 per cent. phenol and the inoculated area is covered with a piece of cotton wet with the same solution and this is allowed to remain three minutes. This is then washed with sterile water and the vaccine collected by curetting. With the rabbit virus there is little if any danger of infection from tuberculosis, syphilis, or foot and mouth disease. Rabbits are not included in Salmon's list of animals subject to foot and mouth disease, and rabbits exposed to the disease apparently did not contract it. The amount of pulp that can be collected from a single rabbit is comparatively small; about an average sufficient for 150 vaccinations can be obtained.

The Technique.—The technique of vaccination is very simple. The first thing to be considered is the site of the vaccination. As a general rule, the left arm is chosen and inoculation made in the neighborhood of the insertion of the deltoid. Occasionally the right arm is preferred, as in left-handed individuals. In girls the leg is usually chosen in order to avoid the unsightly scar on the arm. Some physicians place the inoculation about midway between the knee and ankle on the outer side of the leg.

I prefer a few inches below the knee on the inside, where it gives rise to less discomfort, and where the vaccine vesicle is much less apt to be ruptured. The objection that has been urged to vaccination upon the legs is that, in infants, it is more difficult to keep clean, but with very little care this difficulty can be overcome in the better class of people.—[This is not my experience.—Editor.]

The number of insertions made varies with different practitioners. In America, as a rule, only one insertion is made; sometimes two, placed at least an inch apart; and some authorities advise as many as five placed in the position of the pips of the five-spot of ordinary playing cards with at least one inch of skin between. It is a good plan where possible to make the distance even greater than this, as, when they are placed too close together, the vesicles become large, and there is danger of their coalescing or of the intervening skin becoming ulcerated. The skin should be thoroughly cleansed, a point which is frequently neglected and which frequently results in secondary infections. In people who are not accustomed to frequent bathing the skin should be scrubbed with

soft soap and water; this should be followed by sponging with from 50 to 90 per cent. alcohol for a minute, and this should be allowed to dry completely before the vaccination is done. Sometimes other antiseptic solutions are recommended, but there is always the possibility of their remaining on the skin and interfering with the vaccine virus. The skin is brought on a stretch by using the left hand, and then scarified, and for this purpose various forms of instruments are used, and various forms of scarification recommended.

My own preference is that of a needle, preferably a sharp, straight Hagedorn surgical needle, which is easily kept sterile by inserting it into a cork and keeping it in a small bottle filled with alcohol.

An ordinary lancet may be used, while some physicians prefer a dull-pointed needle or an ivory or bone point. These latter claim that the hemorrhage is less by this method, as the blood vessels are torn by the dull instrument, while they are cut with the sharper one. Small linear cuts a quarter of an inch long are made, and these cuts extend just down to the corium. Care should be taken not to cut them too deep so as to avoid bleeding which may wash out the vaccine virus. If these small cuts are used rubbing in of the virus must be most carefully done, as the area of absorption of it is comparatively small. Small cuts have the advantage of healing rapidly and of presenting less danger of secondary infections; and the disadvantage that with unskilled operators the vaccination may fail to take. Sometimes a small area of skin is scraped with the instrument removing the upper layers just down to the corium. This produces a red, moist surface on which there should be little or no bleeding. This method has the advantage that it is exceedingly easy to secure an effective inoculation, and has the disadvantage that it is more easily infected with extraneous organisms. More recently abrading the skin in a manner similar to the method used in von Pirquet's tuberculosis test has been advised. For this a small instrument not unlike a minute screwdriver is used, and a small circle of skin is denuded by a rotary motion. Another method is the intradermic injection of the lymph, which is done with a hypodermic syringe, the needle being introduced not through the skin but into it, and a small quantity of the lymph injected. Another method is to make cross cuts like the cross-hatching on a drawing, having the cuts about one-twelfth of an inch apart and four or five inches in each direction. This furnishes a fairly large surface for inoculation, and if carefully done heals promptly and leaves comparatively little surface for infection with other organisms. After the scarification is done, the vaccine lymph is thoroughly rubbed in, using the bone or ivory point or the needle which has been used in scarifying. This rubbing in of the virus is very important, and, with

skilled vaccinators and good lymph, almost every vaccination in a primary subject will take; while with unskilled vaccinators there are usually many negative results, due generally to insufficient attention to the rubbing of the virus, sometimes to having the cuts too deep, causing hemorrhage which washes the virus out, and at other times to having the cuts or abrasions too superficial. As to the choice of lymph, my own preference is for vaccine points covered with glycerinated virus and protected by a thick covering of paraffin. The paraffin, being a good non-conductor of heat, serves to protect the virus, and the sterile point furnishes a very satisfactory instrument with which to apply the virus. If the so-called dry points are used the virus should first be moistened with a drop of sterile water. After the virus has been applied, the wound should be allowed to dry. The length of time which this takes will vary from a few minutes to half an hour, depending upon the kind and quantity of the lymph used. When it is thoroughly dry a small pad of sterile gauze should be applied and this should be retained by a few turns of an ordinary roller bandage, or it may be kept in place by an adhesive strip. This should be allowed to remain on for about twenty-four hours, when it may be removed. It protects the wound from external infection, and where this method is followed secondary infections will practically never be met with. The child should not be bathed for twenty-four hours after the vaccination, after which time it may be treated as if nothing had been done. Great care should be taken to protect the vaccinated surface from dirty clothing and from infection by scratching or rubbing. In children with a tendency to scratch, and also in adults with the same propensity, it is a good plan to keep the surface covered with a small pad of sterile gauze loosely applied and held in place by one or two adhesive strips. The average vaccination shield should be avoided; but when the vaccination begins to take, a properly applied shield may be used to considerable advantage. The shield should be deep enough not to touch the vaccine vesicle at any point and should be broad enough to come well beyond the line of inflammation, and should not press on the skin so as to interfere with the circulation. There are almost no shields which fulfill these requirements, and many of the very sore arms are due to too small shields, or shields which have been too tightly applied. A very good method in using a shield is to cut out a piece of gauze and put it beneath the edges of the shield so as to avoid the firm pressure on the skin.

A method of protecting the vaccine vesicle, which I have found to work better than anything else, is to apply an oblong piece of gauze folded some six times and retain this by a strip of adhesive plaster applied around the arm well above and well below the vaccination. If the vesicle is ruptured in any way this dressing prevents secondary infection from taking place. It is cheap, easily applied, easily removed, and may be easily changed when soiled. It should be remembered

in using vaccination shields that they should be removed at least once a day and thoroughly cleansed by the use of boric acid solutions.

The Clinical History of Vaccination.—After the insertion of the vaccine virus, if the wound is unirritated and not infected with extraneous organisms, it usually dries up within the first three days and shows the same appearance as would be noted from an ordinary abrasion of the same character. There may be a transient redness about the vaccination which lasts three or four hours and then disappears. On the third or fourth day the site of the vaccination becomes changed, and a small papule gradually appears. Sometimes this papule does not appear until the fifth or even the sixth day, or later. It is usually, although not always, surrounded by an areola, which is noted below. In the next five days the papule becomes changed into a vesicle so that, on the eighth day after the inoculation, the vaccination presents the appearance of a full, tense vesicle with a depressed center and a shining, mother-of-pearl appearance; and it is at this stage that the humanized lymph is secured by those who use it for further vaccinations. The vesicle is usually small at first, increases in size, and the center becomes depressed or umbilicated. The lymph, which is at first perfectly clear, becomes cloudier and cloudier, until about the tenth day, when it presents the appearance of pus. From then on it begins to dry, and, on the thirteenth or fourteenth day, presents a scab which is thick in the center, thin on the edges, and which comes away between the fourteenth and twentieth day, leaving a red scar which becomes white in the next few months. The appearance of the scar is rather typical, and has been described as having the appearance of having been cut out of the skin with a sharp die. The bottom of the scab is pitted or foveated.

The areola about the vaccination usually comes on about the fifth day, although it may appear earlier, or later. It generally increases until about the tenth day and then subsides, usually rather rapidly. It varies from $\frac{1}{2}$ to 5 cm. in width, and there are variations in different individuals and also with different varieties of lymph, and with the different methods of preserving the same. There is sometimes involvement of the cellular tissue surrounding the vaccination, and there may be enlargement and tenderness of the lymph nodes of the axilla. It is rather difficult to draw a hard and fast line between what might be termed the normal variations of the appearance of the vaccination and variations due to what might be regarded as complications. There are sometimes additional pocks, usually referred to as accessory or supernumerary pocks, which appear about the original vaccination. These are, as a rule, much smaller and are supposed to have resulted from accidental inoculation of imperceptible abrasions or to the transmission of the virus through the lymph channels. Sometimes these may de-

velop on various parts of the body and result in a generalized vaccinia, which is described below. Some of these accessory pocks run the course of an ordinary vaccination, while others may not advance beyond the stage of a papule. The size of the vaccination varies from 1 cm. or less to 2 cm. Occasionally they may be much larger in size, the very large ones usually resulting from the coalescence of two or more vesicles. They may even attain the size of 10 cm. in diameter. The course and general effect of these large vaccinations are about the same as the smaller ones. The contents of the vesicle are also subject to suppuration, more particularly in anemic and run-down children, in whom the pus may be present early and the contents may be watery or at times hemorrhagic.

The course varies somewhat with the virulence of the virus and the amount which has been inserted; and there is some difference due to individual peculiarities; and the course is somewhat more rapid in warm weather than in cold. It is also more rapid in revaccinations.

There are curious variations in the late development of the pock, the vesicle sometimes being delayed for ten or fifteen days, and there are cases in which it does not form for as long as four weeks. This is most apt to happen with dry lymph. At times the vaccination may not develop at first, but, when a second vaccination is done a week or so later, and even as late as three weeks after the first, the first one may start up and run along the same course. Occasionally the vaccination may develop earlier and is referred to as a precocious vaccination. This is rather rare and usually does not vary more than twenty-four hours, so that the appearance usually seen on the eighth day will be present the seventh day. These precocious vaccinations should always be regarded with suspicion, as being due to other processes than that of the vaccine virus, and the source of the lymph should be carefully inquired into. There are variations in the involution due to many causes, to individual peculiarities, to variations in the lymph, to the methods used in vaccinating, and to the treatment of the vaccination itself. When the vaccination is done during the incubation period of some infectious disease, as measles or scarlet fever, there may be marked variations in the course. There may also be variations, as noted below, due to injury in picking off the scab and other extraneous causes. As a general rule, vaccination is complete and the scab separated within three weeks. The constitutional symptoms of vaccination vary greatly. In children under six months of age there is usually little or no disturbance, and this is also largely true for children under a year of age; although in the second six months there are more apt to be some general symptoms than in the first. This may consist simply of restlessness, the child not being quite up to its normal condition, but very frequently there is fever, which usually comes on about the third day. It comes and goes, reaching its height about the eighth day, or sometimes on

the tenth. The older the child the more liable it is to have constitutional symptoms; and adults a little more frequently than children. Sometimes there are loss of appetite and vomiting, and there may occasionally be diarrhea. Sleeplessness is often a prominent symptom, and in older children and adults chills and rigors may be noted. There may be skin rashes, which, as a rule, appear about the fourth or fifth day. These consist frequently of slight erythematous patches or an urticarial eruption. Not infrequently there is an erythematous rash more or less widely distributed which comes on about the tenth day and which has sometimes been called the roseola vaccinosa. This lasts from two to three days and then disappears. The course of the urticarial eruptions is quite variable. Sometimes they come and go, and may last only a few hours; or they may persist for some days. There is a leukocytosis which begins about the third day, increases to the height of the vaccination about the tenth day, and disappears rapidly as the temperature falls. A curious vaccination phenomenon was pointed out by Bryce, of Edinburgh, in 1802. This consists in the fact that, if a second vaccination is done not later than five days after the first, the second vaccination takes just as if it had been a primary one; and it will overtake the first one in its course, mature, and fade at the same time. This attracted considerable attention many years ago, but the practice of repeating the vaccination within the first five days has fallen into disuse.

Treatment of Ruptured and Infected Vaccinations.—A great many of the sore arms are caused by a lack of treatment after the vesicle has been ruptured by an injury. If the gauze dressing above alluded to has been used there will be little danger of the vesicle becoming infected with extraneous organisms, but if the wound comes in contact with a dirty sleeve or is scratched with dirty fingers it is almost certain to become infected and give more or less discomfort, even if the individual is not rendered ill. A certain number of other sore arms are due to vaccination shields being placed on too tightly or being allowed to press upon the vesicle. The shield should always be removed once a day or even oftener, if necessary, and washed with boric acid solution. If the vesicle ruptures it should be washed with a boric acid solution and a dry sterile gauze dressing applied, which can be kept from adhering by the use of a small amount of mild antiseptic ointment, such as boric acid solution. If the wound becomes infected it should be treated just like any other infected wound. For this purpose one of the most effective dressings is 25 per cent. alcohol in which as much boric acid as will dissolve has been added. If the wound ulcerates and is slow in healing, a stimulating ointment may be applied, one containing one dram (4.00 gms.) of bismuth subnitrate and one dram (4.00 gms.) of liquid tar ointment to an ounce (32.00 gms.) of zinc oxid ointment will be found of great service for the milder cases, and the more severe ones may be

painted with a solution of 10 to 20 grains (0.65 gm. to 1.20 gms.) of zinc chlorid to the ounce (32.00 gms.) of water, and, if the granulations are very exuberant, they may be cauterized, preferably by the use of trichloroacetic acid or a crystal of copper sulphate.

[For many years I have made it the rule to apply Lassar's paste upon the vaccinated arm as soon as the pustule begins to form. To this is added salicylic acid to form a one per cent. ointment:

R *Acidi salicylici*, 1.00 gm.; *zinci oxidi*, *amyli* 10.00 gms.; *petrolati*, 80.00 gms.

The arm is douched with sterile lukewarm water twice a day, after which the ointment is applied on sterile absorbent cotton and held in place by a roller bandage. In infants smaller quantities of salicylic acid may be used; in older ones, larger. In doing this no infection occurs, the crust formation is hastened, and detached early, leaving a surface denuded, which heals easily and early. Since I have applied this dressing I have had very little trouble with vaccination. I never vaccinate upon the leg in infants and young children.—Editor.]

Indications for Vaccination.—The German law given above furnishes a good guide. Briefly it may be stated that every infant should be vaccinated during the first year of its life unless there are special contraindications. The younger the infant the less constitutional disturbance will be noted. As a rule, as soon as the infant is gaining in weight and doing well, vaccination may be performed. Between the third and fifth month will usually be found the most suitable time. The vaccination should be repeated some time before puberty, and should be repeated some time after this; always when the individual has been exposed to small-pox or if an epidemic is prevailing. If vaccination is properly done and does not take, it does not harm the individual any; and if it does take it shows that his immunity had partially worn off. The contraindications to vaccination are, first, to avoid vaccinating children who are ill with other diseases and those infants who are not gaining in weight, even though vaccination rarely causes any special disturbance in such infants. Care should be taken not to vaccinate any one during the incubation period of any of the exanthematous diseases. Nor should a child be vaccinated during the course of any of these fevers, so that it is a good plan not to vaccinate children living in houses in which there is a case of an infectious disease. After a child has been vaccinated care should be taken not to expose it to any infection. The child should not be vaccinated if there is an extensive eczema prevailing, nor if it is suffering with any skin disease accompanied with pus

formation, such as furunculosis. It should not be vaccinated if there is a running ear or an abscess, or any suppurating open wound. Bleeders should either not be vaccinated, or, if so, it should be done with great care so as to avoid producing hemorrhage. Cases of leukemia and pernicious anemia should not be vaccinated, nor should any person suffering with a severe constitutional disease be vaccinated unless there is special danger of his developing small-pox, such as exposure to a case or a liability to be exposed during an epidemic.

Influence of Vaccination on the Exanthems.—The course of German measles and scarlet fever is not altered by vaccination. It is possible, though, under certain conditions, that chicken-pox may predispose to a general vaccinia. There are certain difficulties in distinguishing between a general vaccinia and chicken-pox, and the evidence on this point is more or less questionable.

Vaccination in Whooping-Cough.—There has been, for many years, an impression that vaccination done early in the course of whooping-cough exerted a beneficial influence on the course of this disease. This method of treating whooping-cough has not been used very extensively, and yet, from time to time, favorable reports have been made, and, as it is a good thing for every one to be thoroughly vaccinated, there certainly could be no objection to a thorough trial. Mehnert, in South Africa, has reported that, in young infants, the effect was that, as soon as the vaccine pustule developed, the paroxysm of cough became less and disappeared completely in fifteen days at a maximum.

Vaccination Scars.—There is great variation in vaccination scars. The typical scar is a round or oval or somewhat elongated cicatrix with distinct margins. The base is pitted or foveated, and has the general appearance of having been cut out with a sharp die. Sometimes the appearance of the scar is changed by infection of the vaccination wound, or by ulceration of it, so that it may not be typical in its appearance. In some instances the vaccination scar is smooth and on a level with the surrounding skin, and with very small pits, or, in some instances, none at all. The cause of these small pits is a matter of question; some authorities think that they are due to the presence of hair follicles or sebaceous glands, while others believe that they are due to some specific histologic change in the skin at the time of the vaccination. Not all vaccination scars are pitted, although it is the rule. Some other scars, such as those following furunculosis, may present the same pitted appearance and should not be mistaken for vaccination scars. The appearance of the scar differs somewhat with the kind of virus used, and somewhat with the method of vaccination. When the vaccination is done in such a manner as not to disturb the corium, and this escapes injury during the development and course of the vaccination, no scar whatever may be left. The size of the vaccination scar varies. In the days when

human lymph was used the average size was stated by de Cantelou to be from 6 to 9 millimeters. With the bovine virus and the present methods of vaccination, the scar is usually from 10 to 15 millimeters in diameter. Sometimes it may be as small as 4, and at other times it may reach quite a large size. After revaccination the scar is smaller or there may be none; and sometimes white lines are seen even when the vaccination did not take, due to the scratches made at the time of the inoculation. Occasionally there will be slight discoloration of the skin at the site of the attempted vaccination, which may or may not persist. In negroes, and sometimes in other individuals, the scar may be elevated and there may be distinct formation of keloids. The prognostic value of vaccination scars has been studied by Welch and Schamberg. They made careful observations of the scars of all individuals entering the Pennsylvania Municipal Hospital, and they were classified as good, fair, and poor. Under the first head were included all cases presenting typical vaccine scars. Under the second head were included all cases with scars having the same general characteristics but not as distinctly marked; and under the third head all other scars which were said to be due to vaccinations, but which did not resemble the vaccination scar, were included. In many of the cases where there were poor scars it is rather evident that the individual had never been successfully vaccinated. The percentage of deaths in those vaccinated in infancy who had good scars was 6.5; those with fair scars 12.21; and those with poor scars 22.64. Taking all of these together, but bearing in mind that this number undoubtedly includes a number of individuals who had never been successfully vaccinated, the percentage of deaths was 12.53, while the percentage of deaths in the same institution in unvaccinated cases was 41.82. There is some difference of opinion regarding the number of scars. The British Commission believe that the greater number of marks the greater protection is enjoyed by the vaccinated person in relation to small-pox. Welch and Schamberg believe that the quality of the vaccine scar is a far more reliable index of the degree of protection than is the quantity; and in their experience it seemed to make little difference whether there was a single scar or multiple scars, the protection being apparently about the same. One should bear in mind in this connection that the truth of the matter is probably this: that where the multiple scars are the results of several inoculations at the same time the protection afforded is about the same as that produced by one inoculation; but where the multiple scars represent revaccinations at suitable intervals the immunity afforded is greater than where only one vaccination was performed.

Revaccination.—After a person has been vaccinated in infancy the immunity may be perfect and may last a lifetime. In most instances, however, the immunity is either only partial or it wears off after a

VACCINATION

number of years have elapsed. The susceptibility to vaccination seems to be present in about 75 per cent. of the cases vaccinated in infancy, and is noted chiefly at about puberty or in early adult life. We also know that, at the time of small-pox epidemics, many cases occur in persons who have been vaccinated in infancy and in whom the vaccination has not been repeated. There is no way, at the present time, of telling whether a person is immune or not except by repeating the vaccination. The following table by Welch and Schamberg is of interest in this connection:

		Cases	Deaths	Per-centage of Deaths
Under one year	Unvaccinated.....	134	86	64.18
	Vaccinated.....	2	0	0.0
One to seven years	Unvaccinated.....	676	280	41.42
	Vaccinated in infancy, good scars....	11	0	0.0
	“ “ “ fair “	11	1	9.09
	“ “ “ poor “	16	1	6.25
	Total number vaccinated.....	38	2	5.26
Seven to fourteen years	Unvaccinated.....	320	87	27.19
	Vaccinated in infancy, good scars....	61	2	3.28
	“ “ “ fair “	24	2	8.33
	“ “ “ poor “	64	9	14.06
	Total number vaccinated.....	149	13	8.72
Fourteen years and upward	Unvaccinated.....	1,742	868	49.83
	Vaccinated in infancy, good scars....	1,864	138	7.4
	“ “ “ fair “	894	114	12.75
	“ “ “ poor “	1,240	313	25.24
	Total number vaccinated.....	3,998	565	14.13

From Welch and Schamberg, *Acute Contagious Diseases*, 1905, p. 46.

Every one should be revaccinated, and this should be repeated at intervals until the vaccination ceases to take. Revaccination should not, however, be done closer together than four weeks. The course of the vaccination done the second time varies. There may be only a small red papule, which disappears in a few days, leaving no scar; or there may be a somewhat larger papule surrounded by a very faint areola and

followed by the development of a small vesicle. This dries, the scab quickly separates, and there is no scar; or, at other times, the above course may be noted but the vaccination is more decided and the scab more adherent; and when it separates it leaves a slight though usually distinct pitted scar. In other individuals the second vaccination may resemble the primary vaccination and leave just as distinct a scar. One should be careful not to confuse a spurious vaccination with a revaccination.

The question occasionally arises as to whether a person who has had small-pox should be vaccinated. Inasmuch as vaccination, if it does not take, does no harm, such an individual should be vaccinated if exposed to the disease. As a rule, one attack of small-pox confers a complete immunity, which lasts a lifetime, so that, in persons who have had small-pox recently, it will practically always, if not always, be found that the vaccination will not take. It occasionally happens, however, that if the small-pox has been in infancy, or many years have elapsed since the attack, the immunity may not be perfect. I have seen one or two instances of the most typical vaccination in individuals in whom there can be no doubt at all but that they had been through a severe attack of small-pox. The effect of revaccination is to lessen, and, in fact, to almost obliterate, small-pox, as in the German Empire, where revaccination has been practiced since 1875, there have been no epidemics since that time.

Insusceptibility.—This is rare and it is very probable that most of the cases of insusceptibility to vaccination are due to temporary disturbances in the individual or the supposed insusceptibility is due to the use of sterile lymph; probably in almost all cases the latter. It would seem, however, that, in some individuals, at times apparently insusceptible, it may take on a subsequent trial. I have vaccinated some children five or six times before succeeding in getting a successful take, and, in these instances, although the best possible obtainable virus was used, it had been improperly handled at some time and had lost its vitality. There is no reason, however, why a person should not at one time be susceptible and at another insusceptible, just as an individual may be exposed to small-pox and not take it and then take it on a subsequent exposure.

Immunity.—The immunity produced by vaccination varies somewhat with the individual. There may be a few individuals who are naturally immune, but these are rare and cannot be taken into account in considering the question of small-pox from a public health standpoint. Vaccination done in infancy will confer permanent immunity in a certain number of individuals, but in others the immunity becomes weaker as time goes on, so that, in later life, these individuals may take small-pox if exposed to it. If they do take the disease it will be lighter and the mortality very much less. There is no way of telling at the

present time whether the immunity has worn off or not except by a repetition of the vaccination. Individuals who have been revaccinated at intervals until the vaccination done with active virus no longer takes can feel perfectly safe of their immunity. This has been thoroughly demonstrated in cases of physicians and others who may be constantly exposed to the disease. The question of the immunity produced in the children born of women recently vaccinated varies somewhat. Berghardt vaccinated 28 pregnant women and 6 of their children were subsequently vaccinated, all unsuccessfully. Kellogg vaccinated 36 pregnant women; in 14 primiparæ the children were successfully vaccinated when the mother had been vaccinated before the seventh month, and, in the cases in which the mother had been vaccinated after the seventh month the vaccination failed to take. It would seem to show that, in women with their first child, the vaccination done before the seventh month does not confer any immunity upon the infant. In multiparæ the immunity seems to be conferred on the child when the vaccination is done even as early as the fifth month. Small-pox may be transmitted to the fetus *in utero* as early as the eighth month, and such children acquire immunity.

The question of vaccination after the person has been exposed to small-pox has always been a matter of considerable interest. Hanna, from a study of the subject, concludes that vaccination done subsequently to infection with small-pox will take up to the date of the onset, that the individual is afforded protection from small-pox when the vaccination is done within three days (it might be safer to say two days) after infection takes place. If the individual is vaccinated for the first time during this period it may not afford protection, but the case will be a light one. He believes that the disease is somewhat mitigated even if the vaccination is done up to the onset, and possibly even later. Up to the onset of the disease the vaccination runs an independent course. After the onset of the disease the vaccination is, as a rule, not successful, and if it takes it runs an independent course.

VACCINATION COMPLICATIONS AND ACCIDENTS

This is a very large and vexatious subject that has been much discussed, especially by the antivaccinationists, and perhaps the most valuable contributions are mentioned in the Report of the British Royal Commission, 1889-1897. There has been, too, a great deal of discussion of these subjects by the profession, and even the most enthusiastic supporters of vaccination admit that its practice is attended with some disagreeable features; but it should be especially borne in mind that many of these are due to carelessness, sometimes on the part of the

vaccinator, but more often on the part of the person vaccinated. Any other skin wound of the same extent carelessly treated would give approximately the same number of complications. This is a point entirely overlooked by most writers.

The vaccination complications have been variously classified, and, from an etiological standpoint, they may be grouped under the headings of those due to the vaccine virus, and for which vaccination *per se* may be held directly responsible. These changes are, first, the normal vaccination vesicle and the areola around it, and sometimes supernumerary pocks, which three things are not to be regarded, of course, as complications, but as the normal effects of the virus. At times there may be produced a generalized vaccinia, sometimes a profuse erythema, and at others a roseola. Less often there are lichen, miliaria, purpura, erythema multiforme, and urticaria. The second group comprises the definite infections, either local or constitutional. These are noted below, but it might be said in passing that the constitutional infections, if animal lymph is used, are largely mythical. If human lymph is employed syphilis is a real danger, though a very rare one. Septicemia may occasionally occur, just as from any skin wound becoming infected. The third group comprises certain skin diseases which may be associated with or follow vaccination, but which probably have very little if any relation to the vaccination. These vaccination complications may be grouped as follows:

- | | | |
|-----------------|---|-----------------------------------|
| Normal vaccine. | { | Erythematous dermatitis (areola). |
| | | Accessory or supernumerary pocks. |
- Spurious vaccination.
 - Generalized vaccinia.
 - Generalized vaccinia from autoinoculation.
 - Generalized hemorrhagic vaccinia.
 - Generalized gangrenous vaccinia.
 - Generalized vaccine erythema or roseola.
 - Vaccine lichen.
 - Vaccine miliaria.
 - Urticaria.
 - Erythema multiforme.
 - Purpura.
 - Tinea tonsurans.
 - Erysipelas.
 - Impetigo contagiosa.
 - Furunculosis.
 - Sore arm and ulcer.
 - Cellulitis and lymphatic involvement.
 - Hemorrhagic vesicle.
 - Phlebitis.

Local gangrene.

Tinea.

Constitutional Complications:

Syphilis.

Tuberculosis?

Leprosy?

Tetanus?

Septicemia.

Skin Diseases Sometimes Associated:

Pemphigus or bullous eruptions.

Eczema.

Psoriasis.

Lupus.

The dates at which the eruptions and complications may be looked for have been tabulated by Acland as follows:

1. During the first three days: Erythema; Urticaria; Vesicular and bullous eruptions; Invaccinated erysipelas.
2. After the third day and until the pock reaches maturity: Urticaria; Lichen; Lichen urticatus; Erythema multiforme; Accidental erysipelas.
3. About the end of the first week, and generally after the maturation of the pocks: Generalized vaccinia—(a) by autoinoculation, (b) by general infection; Impetigo; Accidental erysipelas; Vaccinal ulceration; Glandular abscess; Septic infections; Gangrene.
4. After the involution of the pocks: Invaccinated disease, for example, syphilis.

COMPLICATIONS DUE TO THE VACCINE VIRUS

Spurious Vaccination.—A curious phenomenon which occasionally is noted is the development of a red papule, usually between the third and seventh day after vaccination. This is at first a sort of raspberry color and crusts form over it, but no real vesicle; and this crust may at times separate or be pulled off accidentally or intentionally. After several weeks or even a month or more this disappears, leaving no scar. It is interesting to note that this was not described during the period in which humanized lymph alone was used. It has been noted by various authors since the general use of animal virus. This is not to be regarded in any sense as a vaccination and confers no protection.

Generalized Vaccinia.—Generalized vaccinia is met with now and then and seems to vary in its frequency in the experience of different observers. I have noted it quite a number of times, and I believe it is

frequently overlooked or not reported to the physician. It is not transmitted from one individual to another except through inoculation, and in this respect differs from small-pox and from chicken-pox. It usually starts between the fourth and tenth day after vaccination, and the eruption comes out in crops so that all stages may be seen at one time. These crops may continue to come out for some days, and may even continue to appear for as long as four weeks, although this is unusual. The number of pocks varies greatly. Sometimes there are only three or four, and at other times they may be very numerous. They first appear as red spots, which change into shotlike papules, and these change into vesicles, and then to pustules, and then dry up. The vesicles are usually present from the third to the ninth day, the maximum development being about the ninth. They remain more or less stationary during the tenth and eleventh days, and then dry up and usually fall off on the sixteenth or seventeenth day. They may come on in the mucous membranes, are apt to be noted in the mouth, and sometimes on the conjunctiva. In this latter situation they may cause considerable pain and be accompanied by a large amount of edema. The eruption in some respects looks like small-pox, and is sometimes mistaken for it, and sometimes for chicken-pox. It may be tested in case of extreme doubt by inoculating it into an animal. It is attended with general symptoms in some instances, and these may be severe but in many cases the indisposition is trifling.

The cause of generalized vaccinia is not entirely clear, but it is evidently due to the transmission of the virus either through the lymph channels or through the general circulation, and it has been observed more frequently when there is a general skin eruption, quite apart from any autoinoculation. It may be produced by the admission of the virus through the digestive tract, through the circulation, or through the respiratory tract. It has been particularly noted in children who have sucked the pocks and so taken the virus into the digestive tract; among those who have noted this is Etienne. It has also been noted in a child sucking the breast of its mother who was undergoing vaccination. A generalized eruption has also been produced by the administration of the dried vaccine crusts with the food, as in the experiment of Cazalas. Sometimes it would seem that the lymph was the cause of the trouble, and there have been various epidemics reported, among which may be noted an epidemic in South Africa observed by Hill and Ross, in which the rash began between the eighth and fourteenth day and continued to come out for some five or six weeks. In this instance the lymph was obtained from one source only, and about three-fourths of the persons attacked were inoculated from a package bearing one number which apparently came from one particular calf, but the total amount of lymph was evidently taken from six different calves, which suggests

a particular quality that was inherent in the strain of lymph and not in the reaction of any particular calf. Chauveau has reported general vaccinia in horses produced by the ingestion of the virus in the alimentary tract, by the respiratory tract, by the circulation, and also by injection subcutaneously.

Generalized Vaccinia from Autoinoculation.—When an individual is suffering with any skin disease or has numerous abrasions upon the skin, and the vesicle upon the arm becomes ruptured, the virus is easily transferred from one part of the body to another, usually by scratching, and in some instances a very severe generalized vaccinia has been produced. Autoinoculations are most common upon the cheek, upon the tongue, breasts, and buttocks, and are liable to affect patches of eczema, owing to the fact that the eczema itches and is scratched, but no part of the body is exempt. When inoculation occurs on the eyelid or on the eyeball, most serious lesions may result and even the sight of the eye itself be lost. There is an instance on record in which a physician vaccinated several children and was then asked by the mother to remove a foreign body from her eye. The physician did this, everting the lid without washing his hands. An accidental vaccination resulted, in which the eye was only saved by a continuous and careful treatment. Sometimes the virus is inoculated about the anus or the vulva, in which case the inoculations may be mistaken for chaneroids or true chanere. The diagnosis is made chiefly upon the typical appearance of the vesicle and subsequently upon the course which it runs, and really should not present any great difficulties to any one familiar with the vaccine vesicle. It not infrequently happens, however, that such cases go for treatment to members of the profession who are not familiar, or only vaguely so, with the appearance of the vaccine vesicle, and mistakes have thus been made. The virus may not only be transferred directly from the vaccine wound, but various objects may be contaminated. Sponges, wash cloths, towels, handkerchiefs, beds, and baths have all served to transmit the virus, and even ointments that have been used on an open vaccine sore have transferred it. There is an instance on record of a gentleman who, being chafed from riding, applied vaselin from a jar that had been used to dress a vaccine sore. This resulted in a very extensive vaccination with marked constitutional disturbances. The only way to avoid these cases of autoinoculation and accidental inoculation is the instruction of the vaccinated individual concerning the possible dangers. But, with the careless tendency of the average human being, it is not to be expected that they will not occur in the future, in spite of warnings.

Generalized Hemorrhagic Vaccinia.—This is a very rare occurrence, and is similar to the hemorrhagic eruption which apparently may occasionally be noted in any of the acute exanthemata. It varies in its in-

tensity, the hemorrhage into the pock may be very marked or it may be very slight. In some cases not all of the vesicles are affected. At the same time there are apt to be petechiæ, subcutaneous ecchymoses, particularly upon slight bruising of the skin, and there may be hemorrhage from the mucous membranes and hematuria.

Generalized Gangrenous Vaccinia.—Under the heading of gangrenous vaccinia two conditions have been confused, one noted below, which consists of a local gangrene at the site of the vaccination, the other a generalized gangrene which starts as a generalized vaccinia and which becomes gangrenous, very similar to the gangrene which is occasionally noted in the course of chicken-pox. Not all of the pocks are affected. There may be only a few or there may be quite a number, and if those affected are situated closely together the gangrene may extend from one to the other. The change usually begins at the latter part of the first week or the beginning of the second. At other times the papules instead of developing vesicles start to ulcerate, increase in size, then turn dark, and there is a sloughing of the central part. This may stop at any time and the patient may recover, or what is more liable to happen is that it may extend, the patient becomes cachectic, and eventually dies. This condition is not very well understood, and it is of such rare occurrence that very little opportunity has been given for the study of it by the more modern methods of investigation. Crocker believes that there is a dermatitis gangrenosa independent of the vaccinia which is possibly due to some pathogenic organism, possibly the *Bacillus pyocyaneus*. Others have believed that the condition was due to some alteration in the tissues due to syphilis, tuberculosis, rickets, or some other constitutional disease, and that changes have taken place in the skin which rendered it particularly liable to gangrene.

Generalized Vaccine Erythema.—Sometimes accompanying the vaccination there is a generalized erythema which may cover almost the entire body, or at other times may only affect portions of it. The eruption is a diffuse blush suggesting erysipelas, but nothing like as intense and usually without any constitutional symptoms. It varies in its appearance, and, at times, in place of being a diffuse erythema, occurs in small blotches, and at other times in small papules, suggesting measles. It usually comes out the ninth or tenth day, but it may appear as early as the third day or as late as the eighteenth after the vaccination. It usually lasts from a few hours to one or two days, and is of very little importance except perhaps from the standpoint of diagnosis. It is most apt to be confused with scarlet fever, with measles, or with erysipelas. The absence of the initial vomiting and high fever, and usually the absence of a sore throat and always of the tongue signs of scarlet fever, should make the diagnosis comparatively easy. It should be remembered, too, that the eruption of scarlet fever consists of minute punctate spots,

which, for the most part, are so close together that they give an appearance of a uniform blush. As a rule, the vaccinia erythema is merely a uniform blush without the punctate appearance. From measles the diagnosis is comparatively easy, owing to the absence of Koplik spots and of the involvement of the mucous membranes. From erysipelas the diagnosis is, as a rule, easy, because erysipelas is sharply outlined, more raised, and more painful, and accompanied by more fever.

Vaccinal Lichen.—This is a rather rare complication, so much so that one is almost inclined to believe that the cases reported are only accidental association of lichen and vaccination. The eruption has very much the appearance of the ordinary lichen, with perhaps a little more irregularity in its course. The eruption consists of small papules, which are red, somewhat conical in shape, and the size of a pin head. They are surrounded by a slight area of redness, and the edge of the papule has a polished appearance, so that it looks as though it had been rubbed over and a portion of it removed. The shape of the papule is not quite round and the outline is more or less angular. Some of the papules are surmounted by minute vesicles and some of these change into minute pustules. It comes out in crops in about one-half the cases, is located on the vaccinated arm, and these are the cases which would seem to have some definite relation to the vaccination. The eruption usually makes its appearance on about the eighth day, but may be seen as early as the fourth day, or as late as the eighteenth.

Vaccinal Miliaria.—This is an eruption of small reddish papules, as a rule scattered over the body, and in many instances the papules are accompanied by small vesicles containing a watery fluid. These dry up after a few days and there may be slight desquamation over the affected areas. The eruption is apt to make its appearance between the eighth and twelfth days, and is not of frequent occurrence.

Urticaria.—This is one of the commonest of the skin eruptions accompanying vaccination, and is met with particularly in children who are known to be subject to this disease; but it may also be met with in children who have never been so affected. The eruption may make its appearance at any time after the vaccination is done, and consists of the typical wheals scattered over the body. Sometimes there are large diffuse areas of redness and sometimes a considerable amount of edema, particularly if the eruption is about the eye. Occasionally the eruption is bluish in color, is always accompanied by intense itching, and is usually characterized by rapid changes in its appearance and location, disappearing from one part of the body and coming out on another. It is frequently the source of further skin trouble due to scratching and infection of the scratch marks with pus germs. It can generally be more or less relieved by thorough powdering with talcum or starch powder, by the application of carbolyzed vaselin, and by sponging with hot

bicarbonate of soda solution. Sometimes menthol solutions are applied, $\frac{1}{2}$ to 1 per cent. solutions in alcohol, painted over the surface, or the same strength used in an ointment. Internal administration of a brisk purge is often useful, as is also the use of some alkali, as magnesia or bicarbonate of soda. Small doses of the aromatic spirits of ammonia are found particularly valuable. The urticaria may disappear promptly or may persist for days or even weeks.

Erythema Multiforme.—This is sometimes met with, and, in the lighter forms, merges clinically with the preceding, the urticaria often preceding an attack and the eruption changing to the typical appearance of erythema multiforme; and there is frequently the addition of purpura. The lesions may also be accompanied by slight swelling and pain in the joints. The lesions, all of which may be seen at the same time, may make their appearance any time between the first and tenth days or even later; and in parts of the body there may be diffuse redness and sometimes papules, sometimes vesicles and even pemphigoid eruptions. At other times the eruption consists of large, more or less round patches, varying in size and shape. These are not infrequently more or less cyanotic.

Purpura.—This may occur in connection with the above, or may be the only skin lesion present. It seems to be analogous to the hemorrhagic eruptions which are sometimes seen with the exanthematous diseases. It may or may not be accompanied by general symptoms. At times there are hemorrhage from the mucous membranes and hematuria, and there may be a slight swelling and pain in the joints.

Tinea Tonsurans.—This occasionally affects a vaccine sore, and it seems rather curious that it is not a more frequent complication. I do not know of any reported cases in America, but it has been noted on the continent of Europe, among others by Hagar and Eichstadt. It results from the transference of the fungus from an infected head to the vaccination, usually by scratching. There are certain forms of tinea met with in the calf, but these apparently have never been transmitted by vaccine virus.

Erysipelas.—This is due to the infection of the vaccination wound either at the time it is made or subsequently with the streptococcus which causes erysipelas. Considering the amount of neglect of vaccination wounds which exists, it seems strange that it is not a more common complication. Erysipelas is not an infrequent disease of infants and may develop quite independently of the vaccination. It has been stated that 2,000 per million infants under three months of age die from erysipelas. It is rather a serious disease when it develops, and when it occurs in infants may frequently prove fatal. The disease is caused by infection, either with unclean hands or instruments, or from lymph containing streptococci, or from unclean garments. Erysipelas follow-

ing vaccination is much less frequent in recent years, owing to the fact that sterile instruments are more generally used and that the vaccine virus practically never contains streptococci, certainly not that used in America. With the proper protection of the vaccine wound erysipelas should almost entirely be done away with. The inflammation of the skin which is seen about the vaccination should not be mistaken for erysipelas.

Impetigo Contagiosa.—This is occasionally met with, particularly in children of the lower classes, and occasionally in infant asylums. It is most apt to occur in children who are living under bad hygienic surroundings and who are anemic or run down in health. The vaccination wound may be infected, or the impetigo may only occur on other parts of the body. It is easily inoculated from one part of the body to another and requires most careful technique to stop it when it is once started. The child suffering with impetigo, or who is exposed to it, should not be vaccinated except under very urgent necessity, such as having been directly exposed to small-pox.

Furunculosis.—This sometimes follows vaccination, and is particularly liable to develop in children who are run down in health, who are not well cared for, and who wear filthy clothing. It is particularly likely to be noted in epileptics and in the insane, especially those who do not keep themselves clean. The disease probably has very little connection with vaccination.

Sore Arm and Ulceration.—It is hard to draw the dividing line between the normal amount of inflammation in a vaccination and an abnormal amount. There is always more or less, as is demonstrated by the areola, which is part of the normal course of vaccination, and this varies in width and intensity in different individuals vaccinated in precisely the same manner. It not infrequently happens that it may extend for many inches away from the vaccination, and there may be considerable swelling. In a certain number of instances the inflammation is due to the infection of the vaccination with extraneous organisms, chiefly the streptococcus and staphylococcus. Infection may take place at the time the vaccination is done, or later, through a rupturing of the vesicle or pustule. Infection is more likely to occur in people with uncleanly habits, especially those who do not bathe frequently, and in whom the skin is liable to be the habitat of pus germs; but it not infrequently occurs from dirty finger nails scratching into the wound, or from coming in contact with filthy clothing. As a matter of fact it has always seemed strange to me that infection occurs as infrequently as it does. The inflammation varies greatly in its intensity. It may be more or less widespread and yet not very painful, and not attended with any great amount of discomfort; while at other times it may be intense, the arm swollen and painful, and the constitutional symptoms marked. The

course of this infected vaccination varies so greatly that all phases of it cannot be described. Sometimes the tendency to ulceration is the most prominent feature. The ulcer may tend to spread, become large in size, discharge foul pus, slightly undermine the skin, and be very slow in healing and leave behind considerable scarring. At other times the process may be intense, but the healing may take place rather rapidly. In other instances there is not much tendency to ulcerate, although there is some; but the surrounding tissues are infiltrated, and a more or less widespread cellulitis results. Following this there may be phlebitis or sometimes lymphangitis, and the lymph nodes in the axilla, which are almost invariably enlarged, may be the seat of suppuration.

Hemorrhage into the Pock.—It sometimes happens that, in place of the normal vesicle, there is a hemorrhagic effusion into it which may or may not be followed by ulceration.

Gangrene of the Pock.—This is not very common, but occasionally is noted following infection. For some reason or other the slough turns dark and a small area of gangrenous skin appears. This is followed by ulceration, the gangrenous portion usually separates, and healing usually takes place with considerable scarring.

CONSTITUTIONAL COMPLICATIONS AND SKIN AFFECTIONS

Syphilis.—There are two things to be considered in connection with this: first, the possibility of getting syphilis through vaccination; and, second, the effect of vaccination in syphilitics. The second point may be disposed of in a few words, as ordinarily the course of vaccination in a syphilitic individual is just the same as in the nonsyphilitic. It occasionally happens that a baby, or even an adult, with active syphilis is vaccinated, in which case the syphilitic lesions may appear upon the vaccinated arm. As a general rule, vaccination should be avoided during the active symptoms of the disease unless there is extreme danger of small-pox. The question of the danger of getting syphilis from vaccination has been done away with since the introduction of bovine lymph, and, as this source of virus is used in most of the civilized countries, the question is almost of academic and historic interest only. But, inasmuch as arm-to-arm vaccination is occasionally still practiced, it may be well to call attention to the principal points concerning this subject, which has been discussed with unnecessary frequency in the past. There can be no question about the fact that, under certain circumstances, where arm-to-arm vaccination is practiced, syphilis may be transmitted. As a matter of actual fact, however, the number of cases of this disease from this source has always been few. Exceptionally the vaccination may be accidentally inoculated with syphilis, as might happen in the case of any open sore. Lee, in 30,000 children examined at the Great Ormond Street

Hospital, in London, found only one case in which it was supposed that the vaccination may have been responsible for the syphilis. Inasmuch as the Great Ormond Street Hospital derives much of its clinical material from a population in which syphilis is not uncommon, it would seem almost strange that more cases of infection of vaccination sores have not been noted. Occasionally there have been epidemics observed, usually where a number of children were vaccinated from the arm of some one having the disease in a latent period. Almost the first, if not the very first, clear case is that reported by Marcolini in 1814. In this instance, from one girl ten children were vaccinated, and from these some thirty more, and a number of these children developed syphilis. In another instance, reported by Tassani, forty-six cases developed in sixty-four children and these infected several mothers and wet-nurses. Altogether there were ten deaths, eight of the children and two adults. Accounts of these epidemics might be multiplied greatly, but they all tell about the same story. Usually the syphilis was in a latent stage, and it is quite probable that a sufficient amount of care was not taken. In 1852 in Bavaria 8 out of 13 children developed the disease, and, from these, 9 other individuals were infected. In this particular instance the physician was condemned by the courts.

There was an opinion held for some time that the disease was transmitted only when the lymph was contaminated with blood, as it usually is in making arm-to-arm vaccinations. This was disproved by numerous experiments and it was found that the disease could undoubtedly be transmitted by clear lymph. In this connection mention should be made of the remarkable case of Dr. Cory, who vaccinated himself four times with the clear lymph taken from undoubted cases of syphilis. The first vaccination was successful; the second, done two years later, was negative; and the third, eighteen months later, was also negative. He then vaccinated himself in three places and developed syphilis from this last vaccination. This and other similar evidence disproved completely the theory alluded to above, which was advanced by Viennois, of Lyons, in 1860. In the transmission of the disease it makes no difference whether the vaccination takes or not. It does not necessarily follow that the disease is always transmitted when the lymph is taken from syphilitic subjects. As a matter of actual fact, the chances of not developing the disease are very good. Jonkoffsky, in St. Petersburg, vaccinated 57 healthy children from the arms of 11 children who were subsequently found to be syphilitic. All of the 57 vaccinations took and in no instance did syphilis develop. The disease may not always be derived from the vaccine virus, but may be transmitted from an unclean lancet or by other means. Kussmaul relates an instance occurring in Lahr (Baden) in 1863 in which a number of children were infected with syphilis, the child from which the virus was derived was perfectly healthy, but the

lancet used had previously been employed in opening an abscess of a syphilitic patient and had not been properly cleansed. The disease develops in from three to five weeks after the inoculation, but sometimes a greater period of time may elapse. The effects of the vaccination have usually passed, and on the site of the scar there develops a papule which ulcerates and presents the ordinary clinical picture of the Hunterian chancre. About the only possibility of mistake in diagnosis is to mistake the chancre for an ordinary vaccination ulcer, or the reverse, mistaking the vaccination ulcer for the initial lesion of syphilis. There are certain differences which should render the diagnosis reasonably clear, especially to those familiar with the clinical history of both conditions. The incubation period of syphilis is usually three weeks or over, and never less than fifteen days; while the ulceration accompanying an ordinary vaccination develops between the twelfth and fifteenth days or even earlier. In syphilis the ulceration is only beginning, or even has not started, on the twenty-first day, while, in the ordinary ulceration, it is fully developed by the twenty-first day. If there are several vesicles, syphilis usually affects but one, while ulceration generally affects all. This is not always the case, and Hutchinson has reported an instance in which three chancres developed on the site of three vaccinations. The amount of inflammation present varies, but, as a rule, in syphilis it is slight, while in the ulceration it is usually very marked. The amount of tissue lost in syphilis is, as a rule, comparatively small, although occasionally the amount of it is marked. In the vaccinal ulceration the ulcer is almost always large and deep. The discharge of the chancre is small in amount or even absent and nearly always dries into scabs, while the discharge from the ulceration of a vaccination is considerable and it does not dry into scabs. The edges of the chancre do not present a punched-out appearance, but slope gradually to the bottom of the denuded surface, while in the ulceration there is the appearance as if the tissue had been cut out. The edges are perpendicular or even undermined, and the shape is irregular. The chancre presents a smooth, even appearance, while the ulcer has unhealthy granulations, often covered with pus. In syphilis the induration is circumscribed and has been described as being parchmentlike, and is easily outlined by palpation. The induration in the ulcer is irregular and apt to be extensive, and is not sharply outlined as a general rule. In syphilis there is no surrounding areola, or only a very small one, while in the ordinary ulceration the areola is very wide, and often presents almost the appearance of a beginning erysipelas. The lymph nodes in syphilis are always enlarged, but they do not suppurate, while in the ulceration they may be enlarged and painful and have a distinct tendency to an acute inflammatory reaction. The eruption in syphilis develops late, usually several weeks after the appearance of the chancre, while the

eruption in the ulceration comes on at the time of the vaccination, usually between the ninth and twelfth days. The eruption in syphilis is characteristic and almost always there are typical mucous patches on the mucous membranes. In the vaccinal ulceration the eruption is as described above under the heading of vaccinal eruptions.

Tuberculosis.—The danger of transmitting tuberculosis from vaccination is apparently purely imaginary. The lymph taken from calves is sure to be free from the tubercle bacilli, as tuberculosis is not apt to develop in calves as young as those used for the production of vaccine virus, and also because of the post-mortem done on the calf immediately after the vaccine pulp is removed. The danger of tuberculosis when human lymph is used is apparently absent, as tubercle bacilli have never been found in vaccine lymph even in vaccinations on advanced cases of tuberculosis. Among other investigations along this line are the experiments of Josserrand, who injected the lymph taken from the vaccine vesicles in persons known to have tuberculosis into animals, and in no instance did any of the animals develop tuberculosis.

Lupus.—The question of lupus has also been raised. While there seems to be no doubt that cases of lupus have developed on the site of a previous vaccination, there is no evidence to show that this was not accidental, and the total number of cases reported is so small as to mean nothing in the vast number of vaccinations done.

Leprosy.—When animal lymph is used there can be no danger of the transmission of leprosy. It would seem that it might be possible to transmit the disease when lymph is taken from individuals suffering with leprosy, and there have been a few reports in which it was claimed that the disease was developed on the site of the previous inoculation. This subject has been given careful study by leprosy experts, among whom must be mentioned Hansen, of Bergen, who does not believe there is any danger of the transmission of the disease through vaccination.

Tetanus.—The development of tetanus after vaccination is rare, and, if the recent experience in the United States is omitted, it is practically unknown. The British Royal Vaccine Commission in 1896 reported only one case. There have been, curiously enough, in recent years in the United States, a number of small epidemics, most of which occurred in 1901. From a study of these cases, as far as it is possible from the reports, it would seem that the disease developed in the vaccine wound from a subsequent infection with the tetanus bacillus. In the first place, the tetanus bacillus does not develop either in the glycerinated virus or on dry points; and, in the second place, other children who were vaccinated with the same lymph as those who developed tetanus remained perfectly well. In most, if not all, instances there is a history of the wound of the vesicle. In some instances the scab had fallen on the ground and had been replaced; and, in other instances, the children played in stables

or in gardens in which manure had been used, and, in one instance, a child slept in bed with its father, who was a hostler. Similar small epidemics of tetanus have frequently been reported quite apart from vaccination. The bacillus of tetanus has practically never been found in vaccine virus in spite of a considerable amount of research along this line.

Septicemia.—There is a certain amount of danger from blood poisoning, as when the vaccine wound is infected it presents the same possibility as is afforded by any other focus in which there are pus germs. Even epidemics of septicemia have been reported, but in every instance the lymph was from human source, and apparently considerable carelessness was used in handling it. Only one epidemic need be cited, and this is one which occurred in 1860 in Massachusetts. A number of children were vaccinated from a bottle containing a mixture of vaccine virus and snow water, which was used to dilute it. The first vaccinations took and ran a normal course. Subsequently, when this fluid in the bottle had decomposed, and had a definite odor, a number of other children were vaccinated and these developed abscesses and showed marked constitutional disturbances. In other instances the infection has come from clothes that have been washed in contaminated water. The methods of wound infection with pus organisms are too well known to require further comment.

Pemphigus.—Curious eruptions of the skin have followed vaccination and some of these have the appearance of pemphigus. In some instances it would seem that there is an individual predisposition to have a bullous type, while in other cases it would seem that a certain strain of lymph is responsible for the lesion. Pernet has observed the fact that this form of disease is more frequent in butchers and those handling animal food products than in other individuals. It may be possible that there is some sensitizing of the tissues which renders the skin more susceptible than that of a normal individual. There have been instances in which there were epidemics, but the disease is not transmitted from one individual to another, and reinoculations of the lymph from the vesicles do not reproduce the disease; and the latter heal without a scar, so that this cannot be regarded as vaccination. Howe, of Boston, reported ten cases, in all of which except one there was a history of a recent vaccination. The shortest incubation period was six days, the average five weeks, and the longest sixteen weeks. They all occurred in adults, and six of them proved fatal. Sometimes there is an eruption of the skin which looks like dermatitis herpetiformis, which comes on about one week after vaccination and sometimes as long as four weeks after, and it may persist for months.

Eczema.—It is not uncommon to see, in infants and in children with a tendency to eczema, an outbreak of this disease following vaccination.

These outbreaks are so common in children with a tendency to eczema that it is not to be wondered at that a vaccination will sometimes start one. There is almost always a history of a family predisposition to eczema. As a general rule, with proper treatment, the attack is not to be feared, and it does not differ from those caused by other kinds of irritation.

Psoriasis.—It has been thought that this is due to vaccination in certain instances, but the evidence on which this opinion is based is very slight. There have been but very few cases reported, and it would seem that, if vaccination were a definite cause of psoriasis, considering the large number of vaccinations done, the disease would be more frequent. There are some fifteen cases in the literature which have been made much of by antivaccinationists and which may be regarded very much in the light of accidental association.

Drug Eruptions.—Care should be taken not to mistake eruptions caused by drugs for disturbances of the skin caused by vaccination. The eruptions from bromids, the iodids, arsenic, and belladonna are the ones most frequently met with, and could easily be mistaken for vaccine rashes. There are instances on record where the eruption caused by bromids and also by iodids has been mistaken for general vaccinia.

THE VALUE OF VACCINATION

It would seem hardly necessary to add a special section on the value of vaccination as a branch of preventive medicine, and yet, in spite of the experience of the past century, and the large quantities of well-known statistical material, there are many who refuse to be convinced that vaccination is the chief means which we have for preventing small-pox, and that it is responsible for the low death rate from this disease in well-vaccinated countries.

There are a number of different ways of proving that vaccination is an effective preventive of small-pox, and among these is the direct inoculation test. This test cannot be made at the present time in most countries, owing to laws against inoculation, but there is sufficient evidence from tests made in the early years of vaccination to convince even the most skeptical.

Inoculation experiments were made by Jenner, who states that upward of 6,000 persons had been inoculated with the virus of cowpox, and the far greater part of these had been inoculated with the virus of small-pox and exposed to its infection in every rational way that could be desired, but without effect.

In America, among the various inoculation experiments, are those of Waterhouse and also those of Dr. James Smith, who was the attending

physician to the County Almshouse in Baltimore, and who published in the *Telegraph*, one of the Baltimore daily papers, December 3 and 5, 1801, full accounts of the cases vaccinated by him in the Almshouse, all of whom were freely exposed to small-pox both by inoculation and in the natural way without any of them taking the disease. There are a large number of similar reports, all of which reach the same conclusion, and which therefore need not be quoted.

It should further be noted that the monkey reacts both to vaccination and to small-pox in the same manner as the human being, and that inoculation experiments have been made upon monkeys with the same results as those mentioned above. That is, that vaccination properly done furnishes a means of protection against small-pox.

A second form of evidence of the value of vaccination is the comparison between the prevalence of the disease before and after vaccination. Aitken states that from 1750 to 1800, according to the investigations of the Epidemiological Society of England, there were 96 deaths from small-pox out of every 1,000 deaths from all causes; while from 1800 to 1850 after the introduction of vaccination, but during the time in which there was no compulsory law, there were 35 deaths from small-pox out of every 1,000. In the various German states during the same periods there were 66.5 per 1,000 in the prevaccination period and 7.26 after the introduction of vaccination. It should be borne in mind that prior to the time of the introduction of vaccination small-pox was a disease of childhood, and that almost all the cases occurred before the seventh year. Haygarth (14) states that about one person out of twenty escaped small-pox. After the introduction of vaccination the age at which the individuals were affected became changed, and now, when vaccination is practiced, it is more common to see cases in adult life than in children. A death from small-pox in a child under five, who has been successfully vaccinated, is a great rarity. In the prevaccination periods practically all the deaths, apart from epidemic years, occurred under ten years of age, and nine-tenths of these were under five years. This statement is not strictly true for all years, but will be found true for much of the period.

Some of the antivaccinationists state that the fall in the mortality rate from small-pox after the introduction of vaccination was due to the discontinuance of small-pox inoculations, but it should be borne in mind that the inoculated small-pox is much less fatal than that acquired naturally, and that individuals having inoculated small-pox must have contributed less to the fatal cases than those who derived it from natural contagion.

Inoculation was introduced into England in 1721, but was not practiced to any great extent until the latter half of the eighteenth century, and even then it never became general. If it caused any increase in

the death rate this increase should have come during the time inoculation was practiced, but, as a matter of fact, the mortality was as great before the introduction as it was afterward, and possibly greater. Inoculation was not practiced in Sweden, or at any rate very sparingly, and the influence of vaccination on the death rate in Sweden was just as marked as in any other country.

Another claim of the opponents of vaccination is that small-pox is less frequent and less deadly owing to the fact that sanitation is better. This, however, is not the case, and we may cite the experience in Glasgow, in which town sanitation was probably worse during the first half of the nineteenth century than it was prior to that time. If we are to judge from certain reports on the sanitary condition of that city made between 1818 and 1838, we may be led to believe that the existing sanitary conditions were about as bad as could be found in any English town, and yet, notwithstanding this fact, the mortality from small-pox decreased nearly 80 per cent. after the introduction of vaccination.

The third way of proving the value of vaccination is to cite the fact that, of the people who are properly vaccinated and who are exposed to the disease, few or none contract it. This is the universal experience in small-pox hospitals, where physicians and nurses are constantly subject to infection, and where it is a very exceptional thing for either to contract the disease.

During the epidemic in Philadelphia a number of workmen employed about the Municipal Hospital directing additional buildings were so close to the patients that they were all advised to be vaccinated. There were between fifty and sixty men, and all except two complied with the request. The only ones to contract the disease were the two who were not vaccinated.

There have been frequent offers made to antivaccinationists to live in small-pox hospitals along with the same number of well-vaccinated physicians and nurses, and to compare the difference in susceptibility in the two classes of individuals, but up to the present time, so far as I know, no antivaccinationists have come forward to accept this method of proving their contention.

That vaccination lowered the death rate and especially in early life is shown by the table giving the annual mortality per 1,000 inhabitants in Sweden. This includes, of course, deaths from all causes. It will be seen that not only is the total rate lowered, but the chief change is in those under 5 years.

Some idea of the death rate from small-pox in prevaccination times can be gathered from a study of the table showing the deaths in Geneva over a period of 180 years. It will be noted that the greater mortality is during the first year of life, and that nearly all the deaths occurred before the first ten years. The reason for this is that nearly every one

THE VALUE OF VACCINATION

95

ANNUAL MORTALITY TO 1,000 PERSONS LIVING—SWEDEN

Ages	Before Vaccination		After Vaccination	
	21 Years (1755-1775)	20 Years (1776-1795)	20 Years (1821-1840)	10 Years (1841-1850)
Under 5 years.....	90.1	85.0	64.3	56.9
5 to 10 years.....	14.2	13.6	7.6	7.8
10 " 15 ".....	6.6	6.2	4.7	4.4
15 " 20 ".....	7.6	7.0	4.9	4.8
20 " 30 ".....	9.2	8.9	7.8	6.8
30 " 40 ".....	12.2	11.6	11.8	9.8
40 " 50 ".....	17.4	16.1	16.7	14.5
50 " 60 ".....	26.4	23.9	26.0	23.6
60 " 70 ".....	48.1	49.3	49.4	46.3
70 " 80 ".....	102.3	104.1	112.9	102.8
80 " 90 ".....	207.8	197.4	243.7	228.5
90 years and upward.....	394.1	351.3	396.4	375.8
All ages.....	28.9	26.8	23.3	20.5

From Welch and Schamberg, Acute Contagious Diseases, 1905, p. 114.

had contracted the disease before ten and had either died or acquired an immunity, so that the number of adults affected with the disease was small and consequently there were but few deaths.

GENEVA, 1580-1760

Small-pox Deaths at Various Ages, 25,349 Cases.

				Years.					
6,792	in age class	0- 1	26.8	per cent.	of the total.				
5,416	" " "	1- 2	21.4	" " "	" " "				
4,116	" " "	2- 3	16.2	" " "	" " "				
2,826	" " "	3- 4	11.1	" " "	" " "				
1,928	" " "	4- 5	7.6	" " "	" " "				
1,325	" " "	5- 6	5.2	" " "	" " "				
944	" " "	6- 7	3.7	" " "	" " "				
543	" " "	7- 8	2.5	" " "	" " "				
454	" " "	8- 9	1.8	" " "	" " "				
345	" " "	9-10	1.4	" " "	" " "				
267	" " "	10-15	1.0	" " "	" " "				
141	" " "	15-20	0.6	" " "	" " "				
87	" " "	20-25	0.3	" " "	" " "				
48	" " "	25-30	0.2	" " "	" " "				
17	in age above	30	0.1	" " "	" " "				

From Allbutt and Rolleston, System of Medicine, v. 2, 1909, pt. 1, p. 776.

The statistics from an epidemic in prevaccination times in Posen, 1795 to 1796, in the villages of Rawicz, Vojanowo, and Sarnowo, are of considerable interest. The population of these three villages was 13,329,

VACCINATION

and 1,252 contracted small-pox, or 9.4 per cent., of which 199, or 1.5 per cent., died; while 15.9 per cent. of those who had small-pox died. The distribution by years was:

From 0- 5 years	743, or 59.3 per cent.
From 5-10 years	441, or 35.2 per cent.
From 0-10 years	1,184, or 94.8 per cent.
Over 10 years	68, or 5.2 per cent.

The prevalence of small-pox varied in various districts and from year to year, as statistics were not always kept in the most perfect manner; but, from the reports which may be regarded as the most reliable, we find that the death rates were everywhere very high. For example, at Kilmarnock, 1728 to 1764, out of every 1,000 children born alive, 161 died of small-pox. In Berlin it was estimated that from one-twelfth to one-thirteenth of the deaths were due to this disease. At the present

TABLES COMPARING SMALL-POX MORTALITY IN VARIOUS LOCALITIES BEFORE AND AFTER THE INTRODUCTION OF VACCINATION

Terms of Years Respecting Which Particulars are Given		Territory	Approximate Average Annual Death Rate by Small-pox per Million of Living Population	
Before Vaccination	After Vaccination		Before Introduction of Vaccination	After Introduction of Vaccination
1777-1806 and 1807-1850		Austria, Lower.....	2,484	340
1777-1806 " 1807-1850		Austria, Upper, and Salzburg.....	1,421	501
1777-1806 " 1807-1850		Styria.....	1,052	446
1777-1806 " 1807-1850		Illyria.....	518	244
1777-1806 " 1807-1850		Trieste.....	14,046	182
1777-1803 " 1807-1850		Tyrol and Vorarlberg.....	911	170
1777-1806 " 1807-1850		Bohemia.....	2,174	215
1777-1806 " 1807-1850		Moravia.....	5,402	255
1777-1806 " 1807-1850		Silesia (Austrian).....	5,812	198
1777-1806 " 1807-1850		Galicia.....	1,194	676
1787-1806 " 1807-1850		Bukowina.....	3,527	516
	1817-1850	Dalmatia.....	....	86
	1817-1850	Lombardy.....	....	87
	1817-1850	Venice.....	....	70
	1831-1850	Military Frontier.....	....	288
1776-1780 " 1810-1850		Prussia (East Province).....	3,321	556
1780 " 1810-1850		Prussia (West Province).....	2,272	356
1780 " 1816-1850		Posen.....	1,911	743
1776-1780 " 1810-1850		Brandenburgh.....	2,181	181
1776-1780 " 1816-1850		Westphalia.....	2,643	114
1776-1780 " 1816-1850		Rhenish Provinces.....	908	90
1781-1805 " 1810-1850		Berlin.....	3,422	176
1776-1780 " 1816-1850		Saxony (Prussian).....	719	170
1780 " 1810-1850		Pomerania.....	1,774	130
	1810-1850	Silesia (Prussian).....	....	310
1774-1801 " 1810-1850		Sweden.....	2,050	158
1751-1800 " 1801-1850		Copenhagen.....	3,128	286

From Welch and Schamberg, Acute Contagious Diseases, 1905, p. 108.

day, in countries where there is no vaccination, small-pox rages just as it did prior to vaccination time. In the Russian Empire, 1893 to 1898, it was stated that there were 275,502 deaths from small-pox. During the same period, in Spain, where the population was only ten and a half million people, there were 23,881 deaths. Throughout China and the East small-pox still continues to rage. Contrast Germany during the five years noted above for Russia and Spain and we find that there were only 287 deaths from small-pox. These figures could be multiplied almost indefinitely, all showing precisely the same thing.

The following table shows very well the difference in the deaths from small-pox before and after the introduction of vaccination, and it should be borne in mind that this table shows the results of vaccination carried out only partially and with practically no revaccination; and does not mean the results now obtained by the use of vaccination and revaccination, as it is done to-day in Germany, for example.

The same thing is shown in a somewhat different manner by contrasting the death rate from small-pox in the vaccinated and the unvaccinated in various countries. The results always include among

DEATH RATE OF SMALL-POX AMONG VACCINATED AND UNVACCINATED
IN VARIOUS COUNTRIES

PLACES AND TIMES OF OBSERVATION	Total Number of Cases Observed	Death Rate per 100 Cases	
		Among the Unvac- cinated	Among the Vac- cinated
France, 1816-1841.....	16,397	16½	1
Quebec, 1819-1820.....	?	27	1½
Philadelphia, 1825.....	140	60	0
Canton of Vaud, 1825-1829.....	5,838	24	2½
Darkehmen, 1828-1829.....	134	18½	0
Verona, 1828-1829.....	909	46½	5½
Milan, 1830-1851.....	10,240	38½	7½
Breslau, 1831-1833.....	220	53½	2½
Württemberg, 1831-1835.....	1,442	27½	7½
Carniola, 1834-1835.....	442	16½	4½
Vienna Hospital, 1834.....	360	51½	12½
Carinthia, 1834-1835.....	1,626	14½	½
Adriatic, 1835.....	1,002	15½	2½
Lower Austria, 1835.....	2,287	25½	11½
Bohemia, 1835-1855.....	15,640	29½	5½
Galicia, 1836.....	1,059	23½	5½
Dalmatia, 1836.....	723	19½	8½
London Small-pox Hospital, 1836-1856.....	9,000	35	7
Vienna Hospital, 1837-56.....	6,213	30	5
Kiel, 1852-1853.....	218	32	6
Württemberg, no date.....	6,258	38½	3½
Malta, no date.....	7,570	21.07	4.2
Epidemiological Society Returns, no date.....	4,624	19.7	2.9

From Welch and Schamberg, *Acute Contagious Diseases*, 1905, p. 117.

the vaccinated those persons who have been vaccinated, no matter what the result, and it is a notorious fact that many vaccinations done in countries where the laws are not strictly enforced are carelessly done, and give negative or imperfect results. But even with these the results are remarkable.

The number of individuals attacked by small-pox will vary with the vaccination and the age. The most striking effect is seen in those under 10 years of age, but it will be noted that the primary vaccination protects the individual over 10 years to quite a considerable degree. Compare the following table with the German results of revaccination:

	Attack-Rate under Ten		Attack-Rate over Ten	
	Vaccinated	Unvaccinated	Vaccinated	Unvaccinated
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Warrington.....	4.4	54.5	29.9	57.6
Dewsbury.....	10.2	50.8	27.7	53.4
Leicester.....	2.5	35.3	22.2	47.6
Gloucester.....	8.8	46.3	32.2	50.0

From Allbutt and Rolleston, System of Medicine, V. 2, 1909, pt. 1, p. 775.

As noted under vaccination scars (which see) the protection will depend upon the thoroughness with which the vaccination is done: A lesson that may be learned by studying the vaccination marks, or, better, by the German methods and results. The following table shows very well the difference in the death rate in those having good vaccination scars, those having imperfect scars, which may be taken as more or less evidence of imperfect vaccination, and those having no scars.

AGES	Vaccinated Good Marks			Vaccinated Imperfect Marks			"Vaccinated," but no Evidence of Vaccination			Not Vaccinated		
	Cases	Deaths	Per Cent.	Cases	Deaths	Per Cent.	Cases	Deaths	Per Cent.	Cases	Deaths	Per Cent.
0-2.....	4	0	0	32	3	9	22	9	41	276	181	66
2-5.....	57	0	0	150	18	12	96	38	40	401	202	50
5-10.....	206	2	1	532	27	5	207	40	19	510	180	35
10-15.....	439	5	1	939	32	3	214	42	20	317	74	23
15-20.....	606	12	2	1,037	66	6	205	39	19	204	86	42
20-25.....	389	11	3	843	100	13	167	56	34	174	83	48
25-30.....	189	12	6	529	80	15	116	35	30	105	56	53
30-40.....	147	14	10	526	78	15	137	49	36	103	42	41
40-50.....	29	4	14	186	33	18	85	24	28	49	21	43
50+.....	19	2	11	80	18	22½	46	20	43	30	13	43
All ages...	2,085	62	3	4,854	455	9	1,295	352	27	2,169	938	43

From Allbutt and Rolleston, System of Medicine, V. 2, 1909, pt. 1, p. 785.

The decrease in the deaths from small-pox in England and Wales, where vaccination is not perfectly carried out, is well shown in the following table:

ENGLAND AND WALES

ANNUAL DEATH-RATES FROM SMALL-POX PER MILLION LIVING, 1848-1903

	Under 5	5-10	10-15	15-25	25-45	45 and Upward
1848-54.....	1,514	323	91	110	69	24
1855-64.....	788.8	209.5	68.7	118.9	87.8	36.2
1865-74.....	782.5	333.2	142.3	267.2	220.7	87.5
1875-84.....	127.8	62.9	46.4	82.4	76.6	33.9
1885-94.....	50.2	14.9	11.1	24.0	31.6	19.0
1895-1903 ¹	31.2	12.6	7.3	10.1	20.9	17.5

¹ Nine years.

From Allbutt and Rolleston, System of Medicine, V. 2, 1909, pt. 1, p. 772.

The vaccination experience in Bohemia as outlined in the English Blue-book for seven years in the prevaccination period and twenty-four years after vaccination was introduced told the same story as the experience in other countries. The population of Bohemia during the first period was 3,039,722. There died annually 94,955, and there died annually from small-pox 7,663. After the introduction of vaccination, with an average population of 4,248,155, there died yearly 139,412, and there died yearly of small-pox 287.

Guttstadt states that in Berlin in the prevaccination period, from 1758 to 1802, the annual mortality from small-pox was over 8 per cent., with some bad years as follows:

1766.....	22.1	per cent.
1770.....	19.2	" "
1786.....	21.2	" "
1789.....	15	" "
1801.....	21.2	" "

After general vaccination in Berlin, the results between the years 1810 and 1814 showed an annual mortality from small-pox of 0.7 per cent., and from 1815 to 1869 the mortality varied from 0.06 per cent. to 0.134 per cent., with an average of 0.8 per cent., or 1-10 of that in prevaccination times. From 1860 to 1870 there was a decrease in vaccination in Berlin, and in 1871 and 1872 the pandemic which swept over Europe affected Berlin very seriously. In 1871 15.7 per cent. died, and in 1872, 3.8 per cent. Comparing the prevaccination times up to 1870,

the following tables from Immermann show the yearly average of people dying from small-pox per 100,000 inhabitants:

1758-1762.....	407 persons	1790-1794.....	310 persons
1763-1767.....	364 "	1795-1799.....	239 "
1768-1772.....	294 "	1800-1804.....	261 "
1773-1784.....	(?) "	1805-1809.....	306 "
1785-1789.....	360 "		

From Nothnagel's Encyclopedia of Practical Medicine, American edition, 1902, p. 230.

1810-1814.....	31 persons	1840-1844.....	13 persons
1815-1819.....	40 "	1845-1849.....	2 "
1820-1824.....	4 "	1850-1854.....	5 "
1825-1829.....	13 "	1855-1859.....	18 "
1830-1834.....	19 "	1860-1864.....	30 "
1835-1839.....	18 "	1865-1869.....	26 "

From Nothnagel's Encyclopedia of Practical Medicine, American edition, 1902, p. 230.

In 1870 to 1874 there was an average of 160 per 100,000 inhabitants a year, while from 1875 to 1884 the yearly average was only 1.16 per 100,000. This remarkable falling off is due to the vaccination law of 1874, which provided, as stated above, not only for vaccination, but for thorough revaccination. The results of this law are very well shown in the following table:

THE RESULTS OF THE GERMAN VACCINATION LAW, 1874

(Small-pox deaths per million living)

1. BEFORE THE LAW OF 1874

Year	Prussia	Bavaria	Württemberg	German Empire ¹	Contrast Austria
1866.....	620	120	133	....	368
1867.....	432	250	63	....	484
1868.....	188	190	19	....	370
1869.....	194	101	74	....	374
1870.....	175	75	293	....	293
1871.....	2,432	1,045	1,130	....	383
1872.....	2,624	611	637	....	1,866
1873.....	356	176	30	....	3,094
1874.....	95	47	3	....	1,725

¹ No statistics.

From Welch and Schamberg, Acute Contagious Diseases, 1905, p. 124.

THE RESULTS OF THE GERMAN VACCINATION LAW, 1874.—*Continued.*

2. SINCE 1874

Year	Prussia	Bavaria	Württemberg	German Empire ¹	Contrast Austria
1875.....	36	17	3	....	576
1876.....	31	13	1	....	406
1877.....	3.4	17	2	....	555
1878.....	7.1	13	0	....	631
1879.....	12.6	5	0	....	534
1880.....	26	12	5.6	....	674
1881.....	36.2	15	3.6	....	807
1882.....	36.4	12	6.6	....	947
1883.....	19.6	6	35.2	....	596
1884.....	14.4	1	11.6	....	530
1885.....	14	3	0	....	600
1886.....	4.9	1	1	4.2	400
1887.....	5	1.8	0	3.5	417
1888.....	2.9	3.8	0.5	2.3	615
1889.....	5.4	5.2	0	4.1	537
1890.....	1.2	1.5	0	1.2	249
1891.....	1.2	1.2	0	1.0	287
1892.....	3	0.5	0	2.1	256
1893.....	4.4	0.7	1	3.1	244
1894.....	2.5	0.3	0	1.7	105
1895.....	0.8	0.2	0	0.5	49
1896.....	0.2	0.2	0	0.2	36
1897.....	0.2	0	0	0.1	61
1898.....	0.4	0.3	0	0.3	....
1899.....	....	....	....	0.5	....

¹No statistics.From Welch and Schamberg, *Acute Contagious Diseases*, 1905, p. 124.

In this connection it is interesting to note the effect of vaccination and revaccination in the German Army. It was introduced into Prussia in 1835. The preceding ten years, in a comparatively small army in Prussia at that time, there were 496 deaths. With the introduction of vaccination, the results are quite remarkable, as shown in the following table:

1835-1844	altogether only.....	39	men
1845-1854	“ “	13	“
1855-1864	“ “	12	“
1865	“ “	1	“
1866	“ “	8	“
1867	“ “	2	“
1868	“ “	1	“
1869	“ “	1	“

1835-1869 altogether only.....77 men

From Nothnagel's *Encyclopedia of Practical Medicine*, American edition, 1902, p. 230

VACCINATION

If one makes a comparison between the number of men dying in the army and the entire population of Prussia, one notes the most striking results in favor of the thoroughly vaccinated army.

(A) AMONG THE ENTIRE POPULATION OF PRUSSIA (according to official reports)		(B) IN THE ARMY (according to Prager, l. c.)
1851.....	2.179 persons	3 men
1852.....	3.208 "	1 man
1853.....	6.734 "	1 "
1854.....	7.490 "	3 men
1855.....	1.664 "	0 "
1856.....	1.270 "	0 "
1857.....	2.330 "	1 man
1858.....	4.691 "	0 men
1859.....	3.530 "	2 "
1860.....	3.461 "	3 "

From Nothnagel's Encyclopedia of Practical Medicine, American edition, 1902, p. 236.

The same thing could be shown by studying the effect of vaccination in other countries, but in no country has vaccination been as constantly carried out as in Germany.

In Chemnitz in Saxony there was an epidemic in 1870 and 1871 which was studied by Flinzer (Immermann). There were 64,222 inhabitants, and of these 53,891, or 83.9 per cent., were vaccinated. Five thousand seven hundred and twelve, or 8.9 per cent., had not been vaccinated, while 4,652, or 7.3 per cent., had already had small-pox. None of these last were affected by small-pox during the epidemic. There were 3,596 cases, or 5.6 per cent. of the total population. Nine hundred and fifty-three were in vaccinated persons and 2,643 in unvaccinated; or, in other words, there was one case in every 56.7 of the vaccinated population, and one case in every 2.2 of the nonvaccinated. The relative mortality from small-pox for the vaccinated was twenty-six times less than for the nonvaccinated. There were seven deaths among the vaccinated and 242 deaths among the nonvaccinated persons. In other words, in the vaccinated there was one death in every 7,698.7, while in the nonvaccinated there was one death in every 23.6, and a relative mortality of 326 to 1. Of the 935 vaccinated persons who had small-pox, 7 died, or 0.7 per cent., and of the 2,643 nonvaccinated persons 242 died, or 9.2 per cent., showing a mortality among the infected of almost thirteen times less in the vaccinated than in the nonvaccinated.

In Japan the history of vaccination is of considerable interest. According to Kitasato, small-pox was introduced into Japan in 123 B. C., at which time it caused a widespread and very fatal epidemic. From that time until 1868, when the present era began, there were some 50 epi-

demics, each one lasting several years and causing great suffering and many deaths. From 1875 to 1884 the number of patients suffering from small-pox averaged 208.1 per 100,000 of the population, while the deaths were only 494.6. There were a severe epidemic in 1885 lasting three years, a reappearance in 1892, when it again lasted three years, and a third outbreak lasting two years, beginning in 1896. In each one of these epidemics there were thousands of cases and thousands of deaths. A somewhat smaller epidemic occurred in 1907.

Vaccination was introduced into Japan in 1849 by a Dutch physician, Monicke, and vaccination stations were established in various cities. About this time, owing to political changes in Japan, all the modern features which had been previously introduced were forbidden, the only survivor being vaccination. The beginning of the first era in 1868 brought about many changes in the civilization of the East. The first vaccination law was passed in 1874, and this was revised in 1885, and more recently in 1909. The most recent law provides that each new-born baby shall be vaccinated within ninety days after birth and before June of the next year. Revaccination shall be made at the tenth year from birth. If either the primary or the secondary vaccination is unsuccessful, the child shall be revaccinated before December of the next year.

The difficulty in Japan has been to secure widespread successful vaccinations, but there is a great deal of small-pox both in China and Korea, and the disease is constantly being introduced into Japan so that in the past there have been epidemics from time to time. With each epidemic vaccination has been carried out, and the effect of vaccination in stopping epidemics has been very remarkable. It will be interesting to note the effects of the new vaccination law, providing it is carried out thoroughly, and doubtless the results will be the same as those in other countries.

Finally the experiences in Cuba and the Philippines show perhaps more conclusively than in other countries, with the exception of Germany, the value of vaccination in the prevention of small-pox.

Small-pox had been endemic throughout the island of Cuba for many years, and as there were no records kept during the Spanish administration there is no way of telling just how many people died, although one can get a fair idea from the mortality in Havana, where statistics are available for the past forty years. The number of deaths varied greatly, several years passing without any, or at other times there were over a thousand a year, and what might be regarded as the normal mortality from small-pox ran into the hundreds. Vaccination had been introduced into Cuba as early as 1804, but with a few exceptional years was never practiced extensively. In 1901 a commission was appointed to revise the vaccination law, and in the same year the new regulation was put into effect by the military governor of Cuba. The result of this was that by the end of the year 1901 Cuba was free from small-pox and the disease

has not reappeared up to this date (1911). The vaccination law is sufficiently strict to result in vaccination in almost all, if not all, of the population, and although the island has been free from small-pox the practice of vaccination has been kept up, there being over 80,000 vaccinations reported in the year 1910.

In the Philippines the results have been just as striking. During the Spanish administration there were large numbers of cases of small-pox—so many, in fact, that large temporary hospitals were erected. Each year during the dry season the mortality was very high. It has been estimated that the annual mortality from small-pox was about 6,000 a year in the six provinces near Manila. Systematic vaccination was completed in 1907, and during the past five years there have been no deaths in Manila from small-pox, and the few scattered deaths which have occurred in the provinces have all been in persons not protected by vaccination. Similar conditions do not prevail all over the islands; for example, in the province of Cepu, prior to 1905, there were from 3,000 to 4,000 deaths each year from small-pox. In 1905 and 1906 there was a systematic vaccination of the 650,000 inhabitants, and in 1907 there were only 94 deaths. In the following two years the vaccination was not done as energetically, and in 1909 small-pox again became bad, and there were 736 deaths, over 90 per cent. of which were in unvaccinated children. Vaccination was again renewed with increased vigor, and since that time small-pox has been practically absent. In the province of Bataan, in the town of Bagac, through a series of unfortunate circumstances, vaccination was suspended during a period of nine years. In 1905 there was a widespread epidemic; a thorough vaccination was done and within two weeks after it was completed new cases ceased to appear, and the town has remained free from small-pox since.

ANTI-VACCINATION AGITATION

Councilman, in his article on small-pox, makes the statement that at the present time the disease is chiefly seen in the most ignorant and wretched population: the strollers who do not acquire a residence so as to be subject to vaccination laws, and the criminals who avoid the laws. The disease is also kept up by a class of people who are either ignorant or have a peculiar order of mind which renders them incapable of sane judgment, and who seek in every way to oppose vaccination. There are always certain members of every community whose minds seem to work in the opposite direction to those of most persons, and these individuals oppose almost everything on general principles. The amount of energy which they display in opposing any new thing and often old-established things is only equaled by the proselytes of a new faith or the propagan-

dists of some new reform. Vaccination has been tested thoroughly in the crucible of doubt, and the result is that, while in the process some of the objectionable features of vaccination have been done away with, the fact as to its efficiency is unquestioned by any one who has made a careful and unprejudiced study of the subject. There can be no question of the fact that vaccination protects the individual from small-pox. The only question which is debatable is whether a compulsory vaccination law is proper from the standpoint that it interferes with the liberty and the personal rights of the individual. On the theory that the government must carry out those things which will work the greatest good for the greatest number, some of the more enlightened countries have insisted on thorough vaccination laws. Every unvaccinated person is likely to take small-pox, and every person with small-pox means a new focus of the disease from which it may spread. The objections which have been urged against vaccination are many, and they have not always been the same. Objections which were very potent many years ago have been entirely abandoned by the antivaccinationists of to-day. The chief objection, that of the possibility of acquiring syphilis, has been done away with through the use of bovine lymph. The danger of acquiring either tuberculosis or leprosy need scarcely be considered. In the early days people feared that in using a remedy which came from a cow there was danger of producing a bovinizing influence on the race and the cartoons of the period show the future generations with horns and hoofs. That there was nothing in this idea has been thoroughly proved by the lapse of time; and this feature is not mentioned by the opponents of vaccination. In earlier days, and even occasionally at the present day, antivaccination agitation is based on religious grounds. This does not carry much weight with it now, but there are still certain pious souls who regard disease as a scourge of God and that any means of combating it should be regarded as a sin. This same argument has been used against many other things.

The most powerful objection has come from the use of antivaccination agitation as a political weapon, and, while in the United States it has not been of much importance, in certain other countries it has been brought into play by unscrupulous politicians who thus secured the aid of an energetic band of workers and of an idea which in many cases was used to screen the real object of the campaign. It has been opposed, too, as mentioned above, as taking away the liberty and free will of the individual; but a man who would wilfully start a new focus of small-pox certainly is as great a criminal as an individual who would wilfully start a fire in some one else's property; and there is no feeling whatever on the part of the community when the rights and the liberty of the incendiary are interfered with. There is also an impression that vaccination increases the general mortality. This can be very easily disproved by

the definite statistics of any country where they are sufficiently complete to be of any value. Thus, for example, in Sweden in the years from 1756 to 1775, that is, before the vaccination time, the yearly death rate was 28.9 per 1,000 inhabitants; in the years 1776 to 1795 it was 26.8, while from 1821 to 1840 it was only 23.3, and from 1841 to 1850 only 20.5. The general mortality of Sweden has diminished one-third. In place of increasing the mortality rate, vaccination in reality lowers it because it removes one of the greatest causes of death. It has also been urged that it affected the mortality of the young. By comparing the actual death rate in Sweden per 1,000 for the different ages, this will be seen to be untrue:

	1776 to 1795	1841 to 1850
Between 0 and 5 years.....	85.0	56.9
“ 5 “ 10 “	13.6	7.8
“ 10 “ 15 “	6.2	4.4
“ 15 “ 20 “	7.0	4.8
“ 20 “ 30 “	8.9	6.8
“ 30 “ 40 “	11.6	9.8, etc.

From Nothnagel's Encyclopedia of Practical Medicine, American edition, 1902, p. 274.

It has further been urged that vaccination increases the number of deaths from other diseases. This is not true, and scarcely needs any consideration whatever. It is extremely rare nowadays to find an anti-vaccinationist who has ever seen a very severe case of small-pox, and, as far as I know, no unvaccinated antivaccinationists have come forward to accept offers that have been made to live in a small-pox hospital along with an equal number of well-vaccinated physicians, so as to note the difference in the number who contract the disease and who die from it.

SUMMARY

1. Up to the time of Jenner small-pox was the most common and most deadly of all diseases.
2. The inoculation as a preventive measure was never very widely practiced, and was open to objections which do not apply to vaccination.
3. Vaccination, properly done, produces immunity to small-pox.
4. Vaccination properly done is practically free from danger.
5. With improved technique, the danger from syphilis has been done away with. There will always be some accidents connected with vaccination, just as with every other human procedure.
6. Immunity is not lasting. One vaccination done in infancy lowers

the morbidity and the mortality, but, as the immunity may partially or completely wear off, revaccination should be practiced at intervals.

7. The individual should be revaccinated, either at the school age, or at puberty, or in early adult life; and subsequently from time to time; and always when a small-pox epidemic threatens, or when the individual has been exposed to small-pox.

8. Small-pox has not changed in its character; and in unvaccinated people is the same deadly disease that it was in prevaccination times. The eradication of small-pox, in so far as it has been accomplished, has been done through the effect of vaccination.

9. Antivaccination agitation, in the light of our present knowledge, is only an exhibition of a certain type of mind which refuses to accept facts and deductions. The fact that vaccination prevents small-pox, when properly performed, is beyond question.

10. Some better method of producing immunity to small-pox may be discovered in the future, but until that discovery is made we must rely on vaccination for the prevention of the disease.

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CHAPTER V

VARICELLA

JOHN RUHRÄH

Synonyms.—Chickenpox, also formerly water pock, glass pock; Latin, *varicella*; French, *la varicelle*, *la vérolette*; Italian, *ravaglione*, *morviglione*; Spanish, *viruelas locas*; German, *Varicellen*, *Windblattern*, *Wasserpocken*, *Schafpocken*.

Definition.—Chickenpox is a specific infectious disease usually characterized by a slight fever, a slight disturbance of the general system, and a characteristic eruption beginning as a papule and rapidly changing into a vesicle which sometimes becomes pustular, but which usually dries and forms a brownish scab, which falls off in from ten days to three weeks after the beginning of the disease. There are exceptional cases in which the eruption is hemorrhagic and sometimes gangrenous. Occasionally troublesome complications arise, consisting chiefly of pneumonia, bronchopneumonia, and nephritis. Sometimes skin infections or abscesses are noted.

History.—It is questionable whether the disease was differentiated by the ancients, but it probably was not; although Hesse, in his voluminous monograph published in 1829, states that there are some authors who believe that the older writers gave good descriptions of the disease. This rests, however, on rather slender authority.

It was separated from smallpox by Vidijs in 1626, and Duncan Liddle of the same period. Fuller in 1730 and Heberden in 1767 gave very clear descriptions of the disease. The question of the identity of the disease and smallpox has been, from the early part of the eighteenth century almost until the present time, a matter of more or less acrimonious debate, the famous dermatological school of Vienna under Hebra declaring the identity of the two diseases. The renewed experience of the severe epidemic of 1870 and 1873, however, again caused the profession to take the view of the non-identity of the two diseases, and I am not familiar with any writers of any importance of the more recent times who have questioned this. It is a question one may regard as definitely settled, although it will doubtless be reopened from time to time. It is

an important one, and the reasons that one may adduce for the non-identity of the two diseases are that smallpox does not protect from chickenpox, nor does chickenpox from smallpox; and, indeed, it is possible to have both diseases at the same time. This has been noted by various observers, Schamberg among others. In cases of chickenpox admitted to the smallpox hospitals through mistaken diagnosis, the chickenpox patients, unless protected by vaccination, may take smallpox, while the smallpox patients, unless they are protected by a previous attack of chickenpox, are liable to contract that disease. Nothing whatever is known of the identity of the virus which causes the disease.

Incubation and Transmission.—Inoculation experiments with the serum from the vesicles usually do not transmit the malady, although a few observers have been able to transmit it in this way. The incubation period in these cases is about ten days; and a general eruption is obtained and not a localized vesicle, as one might suppose. Nothing definite is known as to how the disease is transmitted from one individual to another, nor what is the portal of entry; but that infection takes place nearly always by direct or close contact seems to be well established. The possibility of transmission begins with the first symptoms and lasts perhaps until the crusts have separated, or nearly until this time, so that a safe rule for the isolation of patients is until the body is free from scabs and crusts. There is sometimes gangrene or skin infections which may be prolonged over considerable periods, but in these cases the patient is not to be regarded as a source of danger in transmitting the disease, after the uninfected vesicles have healed and the scabs separated. The disease is rarely, if ever, carried by a third person, and very rarely by fomites, and then only when the exposure takes place shortly after the fomites have left the patient; the virus, whatever it is, seeming to be easily killed by a short exposure to light and air. This is just the opposite from smallpox, in which the virus is resistant.

The incubation period is from thirteen to seventeen days, and, while some authors place the extreme limit as four weeks, it may safely be asserted that there is little or no danger of the disease developing after three weeks have elapsed after the time of exposure.

Susceptibility and Immunity.—Young people are more susceptible than adults, and the disease is rarely seen in full grown people, perhaps for the reason that almost everyone has had the disease during childhood. No age, however, is immune, and the disease may be seen at times in old individuals. Immunity conferred by one attack is usually quite perfect, although second attacks have been reported, and Gerhardt has reported as many as three attacks in the same individual. Varicella occurs with other diseases and runs its course uninfluenced, except that in some instances it may perhaps be more severe. Attacks have been noted after vaccination. Vaccination done immediately before or at the

time the child is suffering with chickenpox takes, as in a normal child, and seems to have no influence whatever on the course of the disease.

PROPHYLAXIS

The prophylaxis of the disease consists chiefly in isolation. The disease is usually so mild and of such benign character that many physicians and most parents make no effort to prevent spread of the disease. It should be remembered, however, in this connection that fatalities may result, that gangrene may occur at times, even in children who are previously healthy, and that, in the very young and very weak children, the disease itself may be a source of danger; or it may so lower the resistance that other infections may be a source of danger to the children. Isolation in schools, hospitals, and other institutions should be rigorously carried out. Chickenpox and measles have the distinction of being the most difficult of all diseases to isolate perfectly, as it would seem that the virus is capable of passing through the air, perhaps on flying particles of dust, for short distances, so that, unless a very rigorous technique with suppression of dust is secured, the disease is very liable to spread (v. Measles). Isolation, where there is a free air space around the isolation ward, is comparatively easy. In private houses isolation is practically of no avail unless the most rigid technique is observed. This consists in isolating the patient and nurse, and in not permitting the other children to come near the isolation room. In almost all households this is impossible, and the best plan is to send the uninfected children away when there is any special reason to avoid infection. Half way isolation is of no value whatever, and, if undertaken, only serves to weaken the faith of the public in the value of attempting to prevent the spread of disease by a method of great importance in the prevention of scarlet fever and diphtheria, the spread of which is so easily controlled.

TREATMENT

The treatment of the patient is usually a matter of considerable ease. In many patients nothing whatever is required. It is a good plan to give a mild purge at the outset, and, if the patient has *fever*, he should be confined to bed. In some instances the fever is high and the general symptoms severe. The fever is usually best controlled by cold sponging, tepid baths, and the use of ice bags. In bathing the child great care should be taken not to rub the vesicles. Sometimes equal parts of alcohol and water are more efficient and will reduce the temperature in a shorter time than water alone, and are useful in lessening the danger of

secondary infections. Alcohol and water for sponging may also be advised if there are many pustules. If the cold applications and sponging do not relieve the *nervous symptoms* accompanying the fever, small doses of antipyrin or acetphenetidin will be found useful.

The Eruption.—In the case of girls the *scarring* is a matter of considerable moment. It should be borne in mind that chickenpox does not scar unless the scabs are picked off and are not allowed to fall off naturally, or when the vesicles become pustules. It is the rule, although not an invariable one, that a pustule will leave a scar consisting generally of a small punched-out typical cicatrix. If two or three of these happen to run together, or if the pustule becomes large, the resulting scar may be quite unsightly. As a rule, most of the chickenpox eruption is on the parts of the body not exposed to light, just the opposite from smallpox; the hands, wrists, face, and neck having comparatively few vesicles. But this is not always the case, and it sometimes happens that they are very numerous on these parts. To prevent scarring, *protection from the light* seems to be of considerable value. Placing the child in a room in which all the actinic rays have been excluded by the use of red glass, or, perhaps, in a more practical manner, by the use of reddish-yellow curtains, which may be had for a very small outlay, may be tried. Or, if this is not possible, keeping the room semi-darkened may be recommended as a substitute; and the wearing of loose gloves and a loose mask over the face may also be tried. In using a mask it should be changed sufficiently often to avoid the danger of infection from its being soiled. As a rule, with proper care, the scarring can be reduced to a minimum, except in the case of young children who are apt to infect the vesicles by scratching. In these, as in other patients, if the tendency to scratch is irresistible, the hands should be restrained. It is well in all cases to pay particular attention to the *cleanliness of the hands*, to have the nails cut short so as to avoid scratch marks.

Itching is the most troublesome symptom of all, and in some patients is very intense. This may usually be controlled by various means. The use of baths or sponging with hot water, to which bicarbonate of soda has been added in the proportion of a teaspoonful to a pint, acts sufficiently in many cases. Dusting with talcum powder or any other bland powder is of great service, and local applications, where the above measures do not suffice, of various antipruritic remedies may be tried. Of these menthol and carbolic acid are the most effectual; the latter may be applied either in the ordinary carbolated vaselin or as a mixture of carbolic acid and glycerin. Menthol is best applied in a one or two per cent. alcoholic solution [or in liquid albolene.—Editor]. A solution of borax in hot water and two to five per cent. of resorcinol may also be tried. Sponging with solutions of alum, 1-5 per cent., is frequently of value. Ichthyol in the form of an ointment is often quite effectual, but

it is a dirty application and should not be used unless other methods fail. In severe cases, where the itching disturbs the rest of the child, the internal administration of antipyrin with or without the addition of codein sulphate, or sodium bromid, is of great benefit. In pruritus about the anus and vulva ointments containing balsam of Peru may be prescribed, as may also ointments containing one or two per cent. of salicylic acid.

The *mouth* is sometimes inflamed. This is due to the presence of vesicles on the mucous membranes, which sometimes leave ulcers. Usually a simple, unirritating, antiseptic mouth wash is all that is needed. If the ulceration tends to spread, the application of burnt alum may be resorted to, and occasionally cauterization with lunar caustic may be advisable. The genitalia should receive especial care, consisting of great cleanliness. If there is any tendency to itching or to infections, some mild antiseptic ointment should be applied. This, perhaps, reduces the danger of severe infections, and possibly of gangrene. If abscesses or local skin infections occur, they should be treated by ordinary surgical methods. A wet dressing with a saturated solution of boric acid and 25 per cent. alcohol is one of the most efficient means of controlling these. If crusts form, due to the drying of pus, they may be removed after softening with olive oil or vaselin. The other complications are treated according to the usual methods. The *hemorrhagic eruptions* are best let alone, although, if there is itching, there is no objection to using the methods referred to above. Antiseptic dressings may be applied when there is gangrene of the skin. I have little faith in any therapeutic measures in the treatment of *gangrene* of the skin in children, although this is a personal opinion based on the observation of not very many cases. Almost all that I have seen have proven uniformly fatal, no matter what was done.

Diet.—The diet in chickenpox should be light during the febrile stage. If there is pain on swallowing, the food should be liquid and given cold.

Convalescence.—During convalescence iron is frequently needed if anemia follows. In the children of the well-to-do, where the child does not rapidly regain its strength, a change of climate may be advised.

CHAPTER VI

SCARLET FEVER

J. P. CROZER GRIFFITH

The treatment of scarlet fever may be conveniently divided into: I. Preventive treatment; II. Treatment of the attack; III. Treatment of complications and sequels.

The study of treatment, however, cannot be profitably undertaken without some review of what is known of the cause and the method of the dissemination of the disease. Great difficulties attend this study, due to the fact that the specific cause is as yet undiscovered. Much can be done, however, in the line of prevention by the consideration of the methods by which the unknown agent is spread.

Cause.—Analogy to other infectious diseases of which the etiology is known indicates beyond question that the cause is a germ of some sort, and that scarlet fever is produced only by the communication of this germ from the sick to the well. Many earlier studies were made in the effort to discover the nature of this, and microorganisms of different sorts were described, but no results of importance obtained. The first investigations of promise were those of Klein (47), who recovered from patients with scarlet fever a microorganism called by him the *Streptococcus scarlatinae* and believed to be the cause of the disease. He found the same germ, too, in connection with the oft-quoted "Hendon Cow Disease," and considered that there was an intimate relationship between scarlet fever and the disease of the udder. Shortly after this we have the description by Jamieson and Edington (42) of the *Bacillus scarlatinae*, which they thought to be pathogenic. Various still later investigations have maintained the etiological relationship of a coccus with scarlet fever. Class (13), for instance, found a diplococcus constantly present in the throat, the desquamating epithelium, and the blood, and Baginski and Sommerfeldt (6) reported a streptococcus in the pharynx as also in the blood of fatal cases. Salge (69) showed that agglutination of the scarlatinal streptococcus was produced by the blood of scarlet fever patients. This is confirmed by Moser and v. Pirquet (58), but denied by others, as Dopfer (19), who failed to find any specific agglutinating

power in the scarlatinal serum. Kolmer (49), also, found an agglutinative reaction with the streptococcus in only a small percentage of cases.

On the other hand, germs of a different nature were described by Döhle (17), who found cocci and flagellated bodies in the blood, and by Mallory (53), who reported a protozoon body, the *Cyclastis scarlatinalis*, present in the lymph spaces and between the epithelial cells of the skin. The discovery of Mallory was corroborated by Duval (21), and by Gamaleia (27); but the bodies are believed by Field (24) to be products of degeneration. The promising investigations of Mallory need, therefore, further corroboration. Quite recently have appeared the interesting investigations by Vipond (81), which report the presence of a specific bacillus in the lymphatic glands in scarlet fever, this being found capable of producing the disease in monkeys. Certain other investigators, too, among them Landsteiner and Levaditi (50a), claim the transmissibility of the disease to the higher apes, but that the nature of the virus is still unknown. Certain "inclusion bodies" have been found by Döhle (18) constantly present in the polymorphonuclear cells of the blood in cases of scarlet fever. This has been confirmed by Kretschmer (50) and by Nicoll and Williams (61). Inclusion bodies have also been found in the cells of the lymphatic glands and elsewhere by Bernhardt (8) and by Höfer (38). Their presence in the blood appears to be of diagnostic importance, but their nature and etiological significance are unknown.

As to the agency of any streptococcus, there is good reason to believe, as pointed out by Hektoen (34), Jochmann (43), and others, that, although a germ of this class is so frequently present, and is undoubtedly closely associated with the disease, it is rather the cause of the complicating angina which so often arises, and of septic conditions in general, than of scarlatina itself. Absolutely conclusive upon this point, if they shall be confirmed by other investigators, will be the experiments of Bernhardt (8). Starting with an emulsion of scrapings from the tongue of scarlet fever patients, and passing the infection through a series of monkeys, he obtained a virus entirely free from streptococci, yet producing in the animals symptoms strongly suggestive of scarlet fever.

The portions of the body which especially harbor the infectious principle of scarlet fever are still not positively known. For many years the desquamating epithelium has been regarded as an element of especial danger. More recent studies, especially by English Hospital physicians (16), are largely in accord and compel us to suspect that the scales possess little, if any, infectious power, except as they have been contaminated by the poison from other sources, especially the mucous secretions.

It seems quite certain, in any event, that the infectious principle resides at least in other portions of the body as well, if not solely there. The contagiousness in those cases in which only a scarlatinal angina has occurred, without any involvement of the skin, is too well known to

demand further notice here. Certainly, then, the secretion from the mouth and nose contains the infectious germ. This view is adopted by many and would appear to be proven with fair certainty by the experiment of Stickler (77), who injected hypodermically 10 children with mucus from the mouth and pharynx. All of these developed severe attacks of scarlet fever. No experiments with blood have been conclusive. Whether the excretions from the bowels and kidneys contain the infectious principle is not certainly known, but analogy to certain other diseases make it probable, and this must be kept in mind in the matter of preventive treatment. The same is true of pus from any source produced during the existence of the disease.

Method of Dissemination and Persistence of Virulence.—This is closely connected with the topic just discussed. The tenacity of life of the germ appears to be variable, but certainly under some circumstances is very great. Some remarkable instances are on record, but are not free from doubt, as, for instance, the case reported by Hildenbrand (37) of over 11½ years, and the still more remarkable case of Boeck, quoted by Johanessen (44), of virulence retained for 20 years. Murcheson (60) gives an instance of persistence of vitality for 4 months; Lommel (52) for 133 days; and Sannée (71) for 73 days. Not only is the germ capable of living for a comparatively long time apart from the body of the host, but it is often difficult to kill, as shown by its persistence in rooms in spite of the disinfecting methods which may have been employed. It is questionable whether the air carries the dry germs in a virulent form to any extent. Close contact with the patient is undoubtedly the most frequent way in which the disease is acquired, but it also seems certain that it is more easily transmitted mediately than, for instance, is measles. The bed and body clothing are ready carriers of the germs, as are books, toys, letters, and the like. The transmission by a third unaffected person is possible, but not common, if any degree of caution is preserved. This appears to be the more recent opinion. It is only where the individual comes into unusually close and prolonged contact with the patient, and without care comes into similar association with others, that any great danger exists. Were it otherwise, we should far more frequently know of transmission by physicians than is the case.

The possibility of the dissemination of scarlet fever by milk is a matter of great importance. Well-authenticated instances have repeatedly been reported where the disease has existed in the families of the milkers and was carried to others. This condition has been studied of recent years especially by Freeman (25) and by Kober (48).

Last is to be mentioned the ready dissemination of the disease by those just beginning to show symptoms, by those convalescent from it, and by those who probably have the disease in an unrecognized form. This can best be considered in the next section.

Period of Greatest Infectiousness.—It appears certain that scarlet fever can be communicated at the very beginning of symptoms, and probably during the last few days of incubation. Were this not the case there would not be the difficulty constantly found in stopping the progress of an epidemic in schools, garrisons, and the like. The onset of the disease is so sudden and the symptoms develop so rapidly that separation of the patient takes place immediately in most instances. This belief in the early transmissibility of infection is the view adopted by many recent investigators. The only objection to its truth is the fact that patients with mild and entirely unsuspected scarlatinal angina may mingle with uninfected persons, and that the spread of scarlet fever may be due to this source. There are sufficient instances, however, where the possibility of this could be excluded to prove that the infectiousness is great, if not greatest, early in the attack, or even just before symptoms appear. On the other hand, the fact that the disease may spread to other members of the family after an inmate of a scarlet fever hospital has returned home, proves that the later periods of the disease are not without danger. The statistics of the English hospitals, where the matter has been studied with especial care, show the occurrence of "return cases" in about 3 or 4 per cent. of all the cases of scarlet fever treated. The sentiment in many hospitals, however, as shown by the collective investigations of Millard (57) in twenty-one institutions, is that this occurrence is no more frequent after 4 weeks of illness, even if the patients are sent home still desquamating, than if the usual 6 weeks of isolation is adhered to. It is to be remembered, too, that transmission of scarlatina late in the attack by no means proves that the infection is produced in the later stages of the disease. It indicates only that it may persist; and it seems very probable that the return cases acquire the disease from patients with uncured affections of the nose and nasopharynx (Barlow, 7; Preisich, 64). It is likely that patients suffering from nasopharyngeal discharge or from purulent otitis, or purulent secretion from other sources consecutive to scarlet fever, may retain the power of communicating the disease for long periods, but that those without these affections are free from danger to others in from 3 to 4 weeks. The uncertainty in this matter is shown by the fact that Igl (40) would make the exclusion from school only 3 weeks, while Schick (73) advises 8 to 9 weeks' absence; and Sörensen (75) says that even this period does not insure safety.

Mode of Entrance of the Germ.—This is as yet not certainly known. The germs in the air close to the patient probably enter the nose and mouth of the exposed individual, and thence spread through the system by way of the bronchi and lungs, or are swallowed and enter through the alimentary tract. With the great susceptibility of the tonsils to the entrance of microorganisms of other sorts, it is very likely that they play

no inconspicuous part in scarlet fever. In the case of infection by milk, entrance of the germs may possibly be either by way of the tonsils or of the gastroenteric tract; in surgical scarlet fever they probably enter through a wound already present.

PREVENTIVE TREATMENT

In the light of what has just been stated regarding the lack of accurate knowledge of the cause and the method of dissemination of scarlet fever, it is evident that methods of prevention cannot be carried out with the effectiveness which is to be desired. Not what is proven absolutely necessary, but what *may* be necessary must be done to safeguard others than the patient. The usefulness of terminal disinfection, for instance, is becoming more and more questionable, as recently well pointed out by Chapin (12), and earlier by many others; but until we have some more positive data on the subject we are safer in going perhaps to unnecessary extremes in the way of preventive treatment.

Quarantine. Isolation.—In view of the fact that the transmissibility of the disease certainly begins early, a patient attacked by scarlet fever should be separated immediately from other members of the family. The question often arises in practice whether intercourse before or at the time the symptoms appeared has not been so intimate that such separation is useless, on the ground that the infection has already been acquired. The event shows that this is true in many instances, but not in many others; and, since no certain conclusion can be drawn in an individual case, and since the disease is a dangerous one, the benefit of the doubt must always be given to those who have been exposed, and further association with the patient should cease. On the other hand, those thus exposed must be viewed as suspects and kept apart from others.

The methods to be followed in the quarantining of the patient and the general safeguarding of others may well be given in fuller detail.

Requirements of the Sick-room.—Other things being equal, the room should be in the upper part of the house, in order to separate the patient as far as possible from other members of the household. This portion of the building is also farther from the noise of the street and of the house in general. Provision must be made for satisfactory heating and ventilation. This is usually, of necessity, such as the already existing construction of the building permits; but when there is any choice in the matter, a room with a fireplace offers many advantages. Heating by oil stoves or gas stoves without direct conduction of the products of combustion to the outside air is a harmful method, while hot-water heating and steam heating make no provision for ventilation. Successful ventilation is well accomplished by the fireplace, if in use, as the draft

produced by the heat draws air through the room from the windows. If no fire is kindled, inspection should be made to insure that the opening of the flue has not been closed by a slide or other cover, as is often the case. Ventilation may also be had through a window, care being taken to avoid direct drafts upon the patient, especially during convalescence. Window-board ventilation is very satisfactory. In other cases a frame covered with cheese-cloth may be fitted in the window to allow free access of air while checking the rapidity of currents. Screens are of great value to protect the patient from direct drafts.

Nothing aids so greatly in the convenience of treating a case during isolation as the possibility of securing a sick-room which communicates directly with another room, preferably a bath-room, this again opening into an entry. With this combination all doors into the sick-room, except that from the ante-room, should be closed, and the cracks about them, as well as the key-holes, stuffed with raw cotton. The door from the ante-room into the entry should be kept closed except at the moments of the necessary gaining access to or leaving the sick-room. At this door a sheet should be hung and kept moistened with a 5 per cent. solution of carbolic acid or a 1 to 1,000 solution of corrosive sublimate. The likelihood of this procedure having any practical value is very questionable, in the light of what has been said earlier, since the disease is probably not spread by flying scales or by currents of air; but, in view of the uncertainty still prevailing, it is a wise precaution, as it can at least do no harm and is an additional reminder to the family and attendants that the disease is an infectious one. The windows in the ante-room should be kept open at all times, if possible, and the door from this room to the sick-room generally closed. In this way the sick-room is practically cut off from the rest of the house, except by what is in reality an out-of-door passage.

All pictures, carpets, curtains, and unnecessary articles of furniture, especially if upholstered, should be removed from the sick-room, and all clothing not in actual use. Only such books or toys should remain to which no special value is attached, and which can be destroyed later. The nurse in attendance upon the patient should wear wash dresses and a rubber, oil silk, or washable covering for the hair. When it is necessary to leave the house, these garments, as well as the shoes, should be discarded in the ante-room, the clothing for out-of-doors put on, and the nurse pass directly out without intercourse with other members of the family. Before leaving the ante-room she should carefully disinfect her face, hands, and neck with a $2\frac{1}{2}$ per cent. solution of carbolic acid or with 50 per cent. alcohol, and gargle her throat with an antiseptic solution, such as liquor antisepticus. It is better, as a rule, that she take her meals in the sick-room or ante-room, rather than in the general dining-room.

Others in necessary attendance should protect themselves and use dis-

infectants in a similar manner. The physician should remove his coat and don a washable gown which fastens closely about the neck and reaches to the floor. On his head he should wear a rubber or washable cap, and overshoes on the feet. When not in use these garments may with advantage be kept in a covered vessel, such as a metal bucket or porcelain jar with a lid, in which a small amount of formaldehyde solution has been placed. The disinfection of the thermometer, stethoscope, and other instruments should not be forgotten.

The food for the patient should be brought to the sheeted door of the ante-room by an attendant and left there for the nurse to take in. All dishes, spoons, and other eating utensils should be washed, and either allowed to soak for an hour in a 5 per cent. solution of carbolic acid, or boiled. The bed-clothing and that of the patient should in like manner be soaked in a 5 per cent. carbolic acid, or a 1 to 1,000 sublimate solution, wrung out, and removed by an attendant from the door of the ante-room. In this condition they may be handled with impunity by anyone and washed with the other household linen. As purchasing a large amount of 5 per cent. carbolic acid solution is an expensive and inconvenient method, a strong stock solution should be prepared, such as the following: Carbolic acid (Calvert's No. 4), 6 fluidounces; glycerin, 4 fluidounces. Adding $2\frac{1}{2}$ fluidounces of this to enough water to make a quart will give approximately a 5 per cent. solution. It should be stirred thoroughly until the carbolic acid is entirely dissolved.

When the disease is over and the patient ready to be removed from quarantine, he should receive a thorough disinfecting sublimate bath of the strength of 1 to 10,000; and have his head washed well with another sublimate solution of the strength of 1 to 2,000. The throat is then to be gargled thoroughly with liquor antisepticus or other antiseptic fluid, the nose douched or sprayed with a saturated solution of boric acid, and the ears douched with the boric acid solution, or with one of 1 to 10,000 sublimate. He should then be removed to another room and dressed in fresh clothing. A final disinfection of the room follows; the floor and woodwork, and the walls, when unpapered, being scrubbed with soap and water and then with a 1 to 1,000 sublimate solution, and the room and its contents subjected to formaldehyde gas for at least 12 hours. The method of employment of this varies considerably. It is more efficacious if combined with steam if the contents of the room permit of this. The formalin candles or lamps are very satisfactory for family use where the local health-boards do not attend to the matter. It is advisable, however, to use the tablets or the candles in at least double the number recommended by the makers. Papered walls had better be scraped and repapered. When it is possible to do so the mattresses and pillows should be removed and disinfected in a municipal steam sterilizing plant, and this applies also to the carpet, if of necessity it has remained on the floor.

Fresh air and sunlight are great disinfectants. It is consequently advisable to allow the room after fumigation to be exposed to both these agencies for a week or more before it is reoccupied. It is, in fact, questionable whether disinfection is of any greater value than thorough cleansing and exposure to the air. However, until the matter is settled, it is certainly advisable to follow every precaution possible.

[I have for many years given up the use of chemicals to prevent the spread of scarlatina, except for fumigation and cleaning walls. Theoretically the efficiency of chemicals has not been proven, and practically nothing can be absolutely proven until the cause of scarlatina is known. If the other more important measures are better carried out by the addition of some harmless chemicals, there can be no objection.—Editor.]

Family.—As it is certain that the disease is spread especially through intercourse, all such must be forbidden as far as possible. Other non-immune children of the family should at once be taken from the house, when this is feasible, and should be kept from school and from other children until such time as the outside limit of a possible incubative period is passed, lest they have the disease already developing in their systems. After this period there is no reason for treating them longer as suspects. The father of a well-isolated patient, if not coming into contact in any way with the child, may continue to attend to his business unless it is of a nature where he is thrown intimately with many young persons. Even under this latter condition there is no special danger, but to avoid criticism it would be better that he change his residence temporarily. Immune children who have already had the disease are in like manner not a source of danger if the patient is thoroughly separated from them; but for the same reason, if they continue to live in the house, they should avoid intercourse with other children until quarantine is removed.

Duration of Quarantine.—The necessary isolation is a matter much discussed. In the mild cases, without especial involvement of the throat and with no nasal or pharyngeal complications, it is probable that 3 weeks is sufficient. In more severe cases 6 weeks is probably safer. When any nasal or oral discharge has continued, quarantine should be extended, and it is uncertain when safety can be assured. In general in scarlet fever 4 to 6 weeks is probably a safe duration of quarantine, the former being, it would seem, just as safe as the latter period, which is the one most generally observed.

Prevention in Hospitals.—The method of checking the spread of the disease is a puzzling proposition which the hospital physician often encounters. When a case of scarlet fever develops in a general ward for children, the usual practice is to remove the patient at once to isolation. When possible the best plan then is to place all the other inmates in a separate ward, where they can be detained until it is discovered whether any of them develop the disease. After the incubative period has elapsed,

and no case has developed, they may all be returned to the original ward. If, however, cases have occurred, those not attacked must remain until the incubative period is again passed. In the meantime the original ward is fumigated and is then ready to receive new patients, thus avoiding the necessity of closing, and the consequent interference with the service. Very excellent results, however, are often obtained by merely removing the patient from the general ward, disinfecting the bed and perhaps adjacent ones upon each side, and continuing to admit other patients as usual. As scarlet fever is a disease which will not spread with anything like the ease of some other infectious diseases, this procedure is a reasonable one. In some hospitals, especially on the continent of Europe, the "box system" is employed. In such cases the affected child is merely surrounded with a box-like screen, sometimes reaching from the floor to the ceiling, and admitting ventilation from a window behind the bed; often not extending completely to the floor and reaching only part way to the ceiling. This screening is done on the theory that the disease is not spread by the air, but by contact. Other children are thus kept from access to the patient, and the nurses are made attentive to the fact that the patient is in a way isolated, and that strict precautionary disinfectant measures are to be followed by them.

There is good authority for all of these methods of procedure described. When, however, a number of cases break out in a ward, there would appear to be no question that the wisest course is to close it entirely for a time, and then disinfect it thoroughly. Sometimes, indeed, even after such disinfection, there appears to persist a remarkable tendency for fresh cases to develop from time to time.

Prevention in Schools.—The readiness with which scarlet fever is communicated before symptoms show themselves, to which reference has already been made in discussing the cause of the disease, renders the prevention of its spread in schools a matter of the greatest difficulty and uncertainty. To allow children to continue at a school where scarlet fever has appeared undoubtedly adds to the danger of their contracting it. On the other hand, to close a school on the development of a few cases interferes enormously with the education of the children in general without corresponding protection, as v. Jürgensen (45) has well pointed out, and is hardly a practicable procedure. He instances the closing of the schools in Tübingen for nearly a year and a half. The only method, both practicable and safe, seems to be at once to prohibit the attendance at school of all members of a class in which scarlet fever has made its appearance, thus keeping away those children who have been most closely associated with the patient, and who may be suspected of being in the incubative period. This applies equally well to day schools and to boarding schools. If the disease becomes at all epidemic, of course the closing of the whole school becomes an unfortunate necessity.

It is to be borne in mind that a general spread of the disease may be even fostered by the closing of a school, since the exposed and possibly already infected children are turned loose to mingle freely with their friends elsewhere.

Prevention by Drugs.—For many years belladonna was advised by the homeopathic profession as a preventive of scarlet fever. Speransky (76) reported cases tending to show that the administration of arsenic was capable of preventing the disease. Other drugs have been recommended, but there appears to be no good evidence that any of them possess a positive protective power.

Preventive Inoculation.—Some work has been done in this line, but with no convincing result. Reference has been made to the experiments of Stickler (77) in injecting children subcutaneously with the mucus from the throat of scarlet fever patients, in the hope of developing an abortive attack, but resulting in producing the disease in a severe form. In portions of Russia a serum devised by Gabritschewsky (26) has been used as a preventive in about 50,000 cases, apparently with good results, the disease being produced in a very mild form. This is said to protect from any recurrence of scarlatina as far as present experience goes. Corroboration of these results is needed. Kolmer (49) found it without value.

TREATMENT OF THE ATTACK

General Hygienic Measures.—Hygienic measures are first to be considered. The selection of the room has already been discussed to a certain extent. The temperature should be not over 60 to 65° F. during the febrile stage, and even after this it is better to keep the room reasonably cool and the patient warm in other ways. Fresh air is essential, but it is important to avoid direct drafts upon the patient, since various complications may follow. This applies, however, chiefly to convalescence, as during the existence of fever it is difficult to effect any dangerous chilling of the patient. The obtaining of fresh air without drafts is, however, a matter easily managed. Reference has already been made to this (page 118). The coverings on the bed should be light during the febrile stage. Later they may be those most comfortable to the patient. Ablution should be given at least once every day. There was never good reason for the once common practice of allowing a scarlet fever patient to pass days or weeks without bathing. Even when fever has ceased there is no possible danger of chilling if the ablution is performed carefully under the bed clothes, or with the uncovering of but one part at a time. The diet should be light, milk constituting the major portion of it. The diuretic effect of milk is excellent, and relieves greatly

the strain thrown on the kidneys in this disease. Where milk is refused or is taken in insufficient quantities, cereal porridges may be employed. Digestible fruits are at all times permissible. In fact, throughout the attack it is important that the patient be not underfed. The giving of meat and eggs, however, is, in my opinion, better delayed until at least after two weeks of the illness have passed. It is important also to ensure that water be taken very freely. This may be either plain or carbonated, or one of the alkaline mineral waters, such as Vichy. In severe cases, where food is refused on account of difficulty in swallowing, or as a result of the unconscious or delirious state, feeding by rectal injection or gavage may be necessary. Under these circumstances the diet ordinarily to be preferred may have to be abandoned and the food administered in concentrated form. Some investigators, among them Gerstley (29a), believe that the administration of a diet containing the ordinary amount of meat has no influence in increasing the number of cases of nephritis.

It has long been a common practice to order a daily inunction with carbolized oil (10 or 20 grains to 1 ounce), with the idea of disinfecting the skin and thus checking the spread of the disease to others. If the scales are as little harmful as is now maintained, this is not necessary. It may, however, be of service in allaying the itching, which is often troublesome. In the case of little children the susceptibility to carbolic acid and the danger of poisonous absorption must be borne in mind. In such cases a weak thymol ointment (1 per cent.) may be substituted if inunction is desired. A daily inspection of the mouth, throat, and nose should be made, in order to prescribe appropriate treatment at once if indicated. The urine should be examined every one or two days for at least three weeks. Rest in bed must be insisted upon even in the mildest cases for 10 days to 2 weeks, and in average ones certainly for 3 weeks in order to avert as far as possible irritation of the kidneys by bodily exercise, and to lessen the danger of a post-scarlatinal nephritis.

Inasmuch as there is reason to believe that cases of scarlet fever with septic manifestations are capable of transmitting this secondary infection to others with the primary disease, the separating of these cases from others is desirable. It would appear, in fact, as though we were dealing with two disorders—that due to the primary scarlatinal toxin, and that depending upon streptococcic involvement productive of complications.

General Medical Treatment in Average Cases.—Little internal medication is required in ordinary cases. Many drugs have been recommended as more or less specific. Illingworth (41) believed that the biniodid of mercury would cut short the attack and cause the rash to disappear rapidly, and this opinion was supported by Dukes (20). Mehary (55) upheld the abortive power of salicin. Curgenvin (14) supported others who believed in the mitigating influence of inunctions of oil of eucalyptus, and Ross (67) thought that decoction of cinnamon could abort an

attack. Other drugs have been recommended from time to time, but there is no positive evidence that any of them possess real value.

The dietetic regimen prescribed and the ingestion of plenty of water may be sufficient to maintain diuresis. In addition a febrifuge and diuretic may be ordered containing, for instance, spirits of nitrous ether, potassium citrate, ammonium acetate, or potassium bitartrate, but no drug which can be irritating to the kidneys. There is no particular value in chlorate of potash in this disease, and it is a remedy capable of doing harm. Warm tub baths are useful to relieve nervousness or restlessness, or to reduce temperature. Stimulants are not required. If the patient is old enough he should employ an antiseptic gargle frequently, such as liquor antisepticus, or permanganate of potash (1 to 8,000). In the efforts to medicate the throat as well as to promote diuresis, the older, well-established custom may well be followed of administering every 1 or 2 hours small doses of the tincture of the chlorid of iron, directing that, although the mouth may be washed afterward, no water may be swallowed immediately. This allows the astringent and distinctly antiseptic chlorid of iron to remain in contact with the throat much of the time.

Nothing is to be gained and much discomfort is caused by overdosing in this disease. The treatment must be purely symptomatic. This brings us naturally to the consideration of the therapeutics of special symptoms, one or more of which may be much intensified in the severer cases. Some of the conditions to be described under complications might readily be spoken of here. In fact the demarcation between complications and symptoms cannot be very closely drawn.

Fever.—Moderate elevation of temperature reaching 103 or 104° F. and lasting but a few days is never of itself a sufficient cause for alarm. It is not so much the height of the temperature as the effect upon the system which demands attention. The employment of hydrotherapeutic measures is generally to be preferred to the administration of drugs if the element of temperature requires active treatment. Sponging with warm water of 90° to 100° F., with or without the addition of alcohol, is often effective, and certainly adds greatly to the comfort of the patient. It must be done thoroughly in order to make it successful in reducing temperature. The bed covers and the greater part of the body clothing should be removed and the patient placed upon a blanket, under which is a rubber protection for the bed. The water should be applied freely, beginning with the head, and the process continued for 10 or 15 minutes, and repeated every 3 hours or oftener. When water of this temperature is not efficacious, cooler water may be used of a temperature of 65° to 80° F., depending upon the case. It is always essential that a good reaction be obtained. If the patient remain cold for any length of time, with blueness of the hands and lips and feebleness of the pulse, the procedure does more harm than good.

Then, too, in the case of children of an age where the application of sponging, even when warm, is often unpleasant and occasions crying throughout the process, the length of time required is a distinct disadvantage. The administration of a warm tub bath is then often not only more grateful, but more efficacious as well, and requires a shorter time. The child is undressed and placed in a bath of 90° to 100° F., where he stays a varying time, averaging 5 minutes, according to the effect produced. He is then removed from the bath, given a very hasty and imperfect drying, enveloped loosely, including the arms, in a blanket pinned under the chin, and put in bed. Here he may be allowed to sleep if he will, while meantime the antipyretic effect continues in favorable cases. Later, in an hour or so, the blanket is removed and the child dried and put into his night clothes. Where there is decided hyperpyrexia with threatening nervous symptoms, more vigorous procedures may be needed. Here a cool bath of 70° may be indicated, or in older, more vigorous subjects, very exceptionally one colder than this.

The warm or cold pack is in many instances more efficacious than the tub bath and better tolerated. It needs to be frequently repeated. Generally it is given in the usual way, namely, wrapping the patient in a sheet wrung out in water, and then, with this in position, wrapping him in a blanket. Should the temperature be alarmingly high, the blanket is not used, but folded towels are dipped in very cold water, pressed out, applied over the patient's body, and redipped and reapplied at short intervals. The cold pack used in this manner is a powerful antipyretic measure and should be used with care. In fact, a caution must be given with regard to all antipyretic procedures. They must never be used as routine measures, simply because a temperature is high, and they must be carefully adapted to each case, which should be meantime carefully watched. The existence of decided cardiac weakness is a contraindication to cool baths, and often to baths of a higher temperature.

It must be remembered that patients in early childhood and especially in infancy usually tolerate cool water badly in any febrile disorder, and warm water is equally serviceable and less dangerous.

Occasionally the need arises for the reduction of temperature in cases where hydrotherapy cannot be employed. Under such circumstances antipyrin or phenacetin may be given, but the effect must be carefully watched. These drugs are usually not depressing in afebrile states, but frequently do cause unfavorable results if febrile temperature be lowered by them too rapidly or too greatly. They should be given in small doses frequently repeated until the desired result is obtained. There are times when they are very serviceable, but these are the exceptions. The inunction of guaiacol carbonate upon the abdomen is also capable of producing reduction of temperature, but often too energetically and unsafely.

Cerebral and Other Nervous Symptoms.—What has just been said regarding the treatment of high temperatures applies here as well, since it is generally in the relief of nervous symptoms accompanying fever that hydrotherapy finds its greatest value. In addition, an ice cap may be applied to the head in the effort to allay nervous excitement, but the effect seems very uncertain, except in infancy, where the depression produced by it is sometimes too great. For restlessness, jactitation, and symptoms of impending convulsions the warm bath of 100° F. is often extremely useful, even when decided fever is present. The bromids, veronal, and sometimes opium are of benefit if restlessness and sleeplessness are great. It is only when decided hyperpyrexia is attended by dangerous cerebral symptoms that the cool bath is to be employed in early life. The coal-tar preparations often fill a useful place in the relief of nervous manifestations, even when no special elevation of temperature is present. Delirium, stupor, jactitation, grinding of the teeth, and similar symptoms are often relieved by them in a manner which can not be satisfactorily explained by the mere reduction of temperature. Nevertheless, the need for this treatment is not frequent, and the danger of too decided a fall of temperature and consequent prostration must never be forgotten.

Cardiac Weakness.—A condition characterized by rapid, feeble heart-sounds and pulse, and by coldness and cyanosis of the extremities, demands stimulation. How energetic this shall be depends always on the needs of the case, and these must be carefully considered, as both understimulation and overstimulation are to be deprecated. Alcohol in some form is one of the most rapid and satisfactory stimulants. Camphor dissolved in almond oil (1 to 10) and given hypodermically is a powerful and quickly acting remedy in urgent cases. [In a large experience in scarlet fever, I have found the double salts of caffein or adrenalin very efficacious in acute myocardial insufficiency in the acute infectious diseases. They should be given hypodermically, first the adrenalin and then, because its effects are more lasting, the caffein. When necessary, venous infusion of a normal salt solution containing the requisite dose should be done. This is reserved for the most urgent cases.—Editor.] Digitalis is invaluable, but takes a day or more before much good can be expected from it, as shown by the experiments of Hale (32), and earlier by many others. The tincture is probably the best preparation, but the strength of this varies greatly. Strychnin is a useful tonic and stimulant, but must not be pushed to the extent of increasing restlessness and sleeplessness, and is always to be avoided when there are symptoms present pointing toward convulsions. Nitroglycerin is an excellent and prompt remedy in urgent indications of cardiac failure. The effect is, however, transitory, and the dose must be frequently repeated while the need for it lasts.

A poorly developed eruption is a common attendant of debility depending upon cardiac weakness. The old practice of giving a hot bath to bring out the rash was often a good one; not that the recession of the rash in itself was a matter of any moment, but that it was an index of imperfect peripheral circulation which the hot bath tended to relieve.

Sepsis.—Sepsis develops generally from a local lesion of the throat, as seen in anginose scarlet fever, and the constitutional involvement may be at first, or remain, not great. In other cases there is early evidence of widespread septic poisoning. The treatment must be supporting and stimulating. As forms of streptococci are the cause of the condition, it is here particularly that the antistreptococcic serum should offer the greatest hope of benefit. The results are, however, questionable, as the nature of the streptococcus is not certainly known (see Serum Treatment). Hypodermoclysis, enteroclysis, and even intravenous injection of a physiological salt solution are indicated in the effort to eliminate the toxins from the system.

Treatment of Convalescence.—Apart from the care in the matter of exercise, diet, and exposure already referred to, patients during convalescence frequently require tonic treatment for a degree of debility which often continues, and which is quite decided after severe cases. Change of air is now one of the best remedies, selecting by preference localities where the patient can be in the open air the greater portion of the day. The anemia which often remains demands the administration of iron in some form for a considerable time. Strychnin, too, is a serviceable general tonic.

Serum Treatment.—Many attempts have been made to modify the course of scarlet fever by the use of specific sera. The results have been far from uniformly satisfactory, and the opinions of those who have used them are greatly at variance. One of the earliest employed was Marmorek's (54) antistreptococcic serum, applied by himself to the treatment of scarlet fever, on the ground that this disease was due to a streptococcus. Inasmuch, however, as the serum was one prepared from the streptococcus pyogenes derived from patients with other diseases than scarlet fever, theoretically the results could not be encouraging. Baginsky's (6) experience with it was not satisfactory. Good results might with reason be hoped for in septic complications, and such, indeed, have repeatedly been reported. Later a serum was prepared by Aronson (2) by the inoculation of horses with streptococci derived from various sources from patients with scarlet fever. The antistreptococcic serum prepared by Menzer (56) was tried in scarlet fever by Heubner (36), but without encouraging results. Campe (11) reported favorably on the serum prepared by Marpmann, derived from the scales, urine, and blood of scarlet fever patients, and rather an extractive substance than one based upon the presence of streptococci. Van Lier (80) obtained no discoverable re-

sults in 40 cases. Hartung (33) believed the action favorable. The injection of the blood serum derived directly from patients convalescing from scarlet fever has been recommended by Roger (66), Weissbecker (82), Huber and Blumenthal (39), Leyden (51), and others, but the results have not been convincing. Various other sera have been employed, but the one which has excited the greatest attention, and the application of which promises most, is that prepared by Moser (58), by a method somewhat similar to that used by Aronson, except that cultures were made from the blood of various scarlet fever patients, and horses inoculated with these. The serum was thus of a polyvalent nature. He reported excellent results, and the value of the treatment has been maintained by many, among them Escherich (22) and others; while still others (Heubner, 36; Ganghofner, 28) contend that no good results follow.

Of the value, indeed, of serum treatment in general, so much has been written in recent years that a full account would occupy more space than is possible here. An excellent review of much of it can be found in the contributions of Saltykow (70) and Fedinski (23). Although the results of trial are contradictory, enough has been done to warrant the employment of serum, especially against the septic manifestations.

TREATMENT OF COMPLICATIONS AND SEQUELS

Affections of the Throat and Nose.—Involvement of the throat in moderate or slight severity so consistently constitutes a manifestation of the disease that it might well be considered under symptomatology. When severe enough to demand special treatment, the nasal and pharyngeal conditions are rather to be regarded as complications. As in the case of all complications of scarlet fever, prevention is to be attempted in every way possible. The systematic spraying of the throat with antiseptic solutions and the use of antiseptic gargles aid greatly in hindering the development of streptococcic invasion of these mucous membranes. When evidences of rhinitis are already present, the nose should be sprayed or syringed several times a day with a mild, warm solution of boric acid, a very weak solution of salicylic acid or thymol, or even with a warm normal saline solution. The syringing must be done with gentleness, avoiding the forcing of septic material into the Eustachian tube, with consequent infection of the ears. Pseudodiphtheritic (streptococcic) involvement of the fauces often requires more energetic local treatment. Gargling is now inefficacious, even if the patient were well enough to perform it thoroughly. Remedies are best applied directly, every two to three hours, with a spray or on a swab of cotton wrapped firmly on an applicator, which is more satisfactory than the ordinary camel's hair brush. Diluted peroxid of hydrogen (1 to 2) is an excellent cleansing, antiseptic

substance, care being taken that a preparation is chosen free from decided acidity. In many cases, where no large amount of membrane has formed, this alone is sufficient, the treatment being repeated every three to six hours. Other suitable applications for swabbing are permanganate of potash (1:40) and corrosive sublimate (1 to 5,000); and one of the best is diluted tincture of the chlorid of iron (Tr. ferri chloridi, 1, glycerinum, 1, aqua, 2).

Nitrate of silver in solution (5 or 10 gr. to 1 oz.) is a remedy employed by many, and some of the newer preparations of silver are also useful.

In addition to the means described, the use of ice bags over the region of the tonsils and the frequent sucking of ice aid decidedly in limiting the degree of inflammation and relieving pain to a considerable extent.

Always in making applications to the throat the exhaustion which follows the struggle of a rebellious patient must be balanced against the good which the treatment may produce, and this is a matter which requires careful consideration and sound judgment. When it is deemed inadvisable to paint the throat, reliance must be placed upon atomization, employing for this purpose peroxid of hydrogen, or such solutions as those recommended for use in the nose.

Sloughing of the tonsils requires the repeated application of powerful disinfectant solutions, such as the tincture of the chlorid of iron, best in the form of Loeffler's solution with toluol, or the employment of cauterization. True diphtheritic involvement of the fauces and nose is a complication of sufficient frequency in scarlet fever to influence many fever hospitals to give routinely immunizing doses of diphtheria antitoxin to all scarlet fever patients. Should any pseudomembrane develop in a case of scarlet fever, the case should be treated as an ordinary one of diphtheria, even without waiting for the result of the culture, which should be taken promptly.

Severe anginose symptoms in scarlet fever always constitute a serious complication of the disease, and demand, besides the local measures described, vigorous supporting treatment. They are, in fact, a local septic manifestation with more or less general septic involvement. Swallowing is frequently difficult and always painful, and much persuasion may be required to make the patient take sufficient nourishment. It may consequently become necessary to give all food in a concentrated form, or even to employ rectal feeding or to use gavage.

Otitis.—This is a frequent complication and sequel of scarlet fever found by Pugh (65) in 15 per cent. of 11,000 cases, and by Gordon (31) in 19.5 per cent. of 8,695 cases. These figures are exclusive of the cases in which there is merely slight pain in the ears. Avoidance of

the disorder is, therefore, to be sought from the outset of the attack of scarlet fever. Faithful disinfection of the throat and nose in the manner already described doubtless will prevent the disease in many instances. The wearing of a flannel cap covering the ears is also advised, with the intent of equalizing the circulation through this region. Should otitis develop, as shown by the increase of temperature and by severe pain and tenderness, the cap should certainly be applied and a hot water bag kept in apposition to the ear. Douching the canal with water as hot as can be borne with comfort aids in relieving the congestion. The instillation of a few drops of a solution of adrenalin chlorid or of a 4 per cent. cocain solution is also often successful in relieving pain. The process is, however, very liable to advance to suppuration, and perforation occurs if paracentesis has not been required for the relief of pain before the discharge takes place of itself. In quite young patients it not infrequently happens that the diagnosis of otitis is not made, owing to the absence of definite complaint, and treatment cannot be employed until perforation and discharge of pus occur. After perforation the treatment is that for suppurative otitis in general, the chief object being to maintain the canal in an aseptic state. The possibility of the development of mastoid abscess is always to be borne in mind, since prompt surgical interference may be required in this event.

Cervical Adenitis.—A moderate enlargement of the glands is nearly always present when inflammation of the throat is a decided symptom. This occurs early, and not infrequently becomes later a condition demanding treatment. In the severe anginose cases an extensive inflammation of the glands and surrounding cellular tissue may take place early, producing, it may be, great swelling of the neck. The condition may become a gravely septic one. Ordinarily adenitis sufficient to constitute a complication or sequel occurs later in the disease. Schick (72) reports it a sequel in 7.2 per cent. of 900 cases, and Caiger and Dudgeon (10) in 11.4 per cent. of 10,983 cases. In the milder cases resolution takes place of itself, or may be favored by the continued application of an ice bag, with, however, a layer of cloth between the bag and the skin. In other cases iodine or ichthyol is successful in checking the process. Painting the glandular region with a thin layer of flexible collodion has also been found useful through the pressure which it exerts. Tonic treatment, especially with iron and strychnin, is indicated also in these cases. Where pus is evidently forming, the pain is best relieved by hot applications, which hasten the process and thus curtail the duration of suffering. The pus should be evacuated as soon as it approaches the surface. Nothing much is gained in these cases by an early, deep incision, since, if destruction of the gland has already begun, it will continue until it is entirely broken down and discharged. By this is not meant that a large amount of pus should be allowed to accumulate before being

evacuated. In the gravest cases, where early extensive inflammation of the glands with cellulitis attends severe anginose scarlet fever, prompt and free incision is indicated if pus is being formed, or even without waiting for certain indications of this (v. Angina Ludovici).

Gastrointestinal Complications.—Digestive disturbances are not, as a rule, troublesome. Diarrhea is a frequent complication, but seldom of an inflammatory nature, and treatment is usually not required, and in any case is that for mild diarrhea of catarrhal origin, such as the administration of bismuth, or perhaps opium. The tendency to diarrhea in this disease is, however, a warning not to use purgatives too freely early in the case. Constipation sometimes requires treatment, but is best relieved by suppositories or injections. The initial vomiting which ushers in the disease usually disappears promptly. In some cases, however, it may persist very obstinately. In this event carbonated water, cracked ice—which should be swallowed, not sucked—equal parts of lime water and cinnamon water, or similar preparations may be employed. Occurring later, vomiting is oftenest a symptom of uremia, and will be referred to in considering nephritis.

Arthritis.—This is seen as a complication or sequel in very varying frequency: 2.4 per cent. in 500 cases reported by Ashby (3); 19.1 per cent. of 1,000 cases recorded by Herberg (35). Whether or not it is at all rheumatic in nature is disputed, and this renders the treatment very uncertain. Nevertheless, the administration of salicylates may well be tried, together with the application of protective dressings to the affected joints. In the more unusual septic cases, where suppuration follows, surgical measures are often called for.

Nephritis.—Involvement of the kidneys is one of the most dangerous complications and sequels of scarlet fever, and a frequent one. Omitting from consideration the slight albuminuria with cylindroids and hyalin casts which is liable to occur in any febrile infective disorder, the frequency of nephritis seems to vary with the epidemic. Ashby (4) found it in 6 per cent. of the cases; Caiger and Dudgeon (10) in 4 per cent. of 10.983 cases; Royer (68) in 7.76 per cent. of 756 cases. It occurs certainly often enough to make it a serious consideration whether anything can be done which will perhaps prevent it. The etiological influence of exposure to cold is questioned by many authorities and has certainly been overrated. As, however, local surface chilling undoubtedly increases the hyperemia of the kidneys, there seems no reason why this should not favor the action of any germs or toxins upon these organs. All such exposure is, therefore, certainly to be avoided as long as any doubt continues regarding the etiology. These remarks apply principally to surface chilling after fever has disappeared. During pyrexia it is, as previously stated, doubtful whether patients can be given "cold" in this way. In the same way, rest in bed and the consumption of an un-

irritating diet lessen the work which the kidneys are called upon to perform, through the action of these procedures in diminishing the energy of the metabolic processes of the body. The employment of diuretic remedies as preventive measures has already been referred to. Royer (68) found that the administration of chloral, previously recommended by others, lessened the incidence of nephritis. Urotropin, first advocated by Widowitz (83) for the same purpose, has been highly praised by Buttersack (9), Patschkowski (63), and H. P. Thompson (78). Garlipp (29) has not found it serviceable. Further studies are needed. On theoretical grounds the drug should prove of value. The employment of turpentine for the same purpose was urged by Tobietz (79). A salt-free diet was advocated as a preventive of nephritis by Deléarde (15), confirming the earlier report upon it by Guinon and Pater, but the experience of Nobecourt and Merklen (62) found it not equal to a milk-diet for this purpose.

Nephritis actually developed may show itself in several ways and demand corresponding variations in the method of treatment to be employed. There may be a sudden onset of moderate edema of the eyelids, hands, and feet; fever; and scanty, high-colored urine, but without any nervous symptoms of note. In such cases the use of mild diuretics, such as acetate of potash or citrate of potash, the administration of saline purgatives in moderate doses, and the employment of warm baths and of large, warm, saline enemata, is of service in maintaining the action of the kidneys and in supplementing this by favoring excretion through the bowels and the skin. The diet should consist solely of milk. Large amounts of water should be taken, and rest in bed must be absolute. It is important that the bed be well warmed before the patient is returned to it after the warm bath, and that he be well covered while in bed. The baths may be given once or twice daily and last 15 minutes or longer.

In severer cases symptoms similar to those described occur, to which are added those of decided uremia; or the urine may exhibit the gross appearance of a true hematuria. Vomiting, convulsions, and similar symptoms develop. Dry cups over the kidneys are of service, or even wet cups if the suppression of urine is nearly complete. The hot air bath or vapor bath now fills a very useful purpose; or the patient is put into a hot bath of 100-105°, left there a few minutes, and then removed and enveloped in hot blankets without drying. This tends to produce profuse perspiration. Pilocarpin is a useful remedy for adults, but is dangerously depressant for children. Both Allaria (1) and Sheffield (74) have seen the convulsions of scarlatinal uremia relieved by lumbar puncture. The latter writer employs also hypodermic injections of morphin and atropin. Vomiting is relieved principally by reëstablishing the action of the kidneys. V. Jürgensen (46) recommends for it minute doses of tincture of iodine.

In cases of hematuria, in which sufficient blood is lost to demand treatment, ergot or calcium chlorid may be tried, and later the continued administration of iron, as in Basham's mixture.

The most common complex of symptoms in scarlatinal nephritis, however, is that appearing in the third or fourth week of the disease. Although evidences of uremia may appear here also, the most prominent manifestations are usually those of dropsy. There develops a widespread dropsy, perhaps involving the serous cavities as well. Generally the onset is insidious and the development of symptoms gradual. In the acute stage of this "post-scarlatinal nephritis" the treatment is very similar to that spoken of for the nephritis occurring earlier in the disease, except that special attention must be given to the removal of dropsy by purgation and sweating. Relief of the serous cavities by tapping may be required.

When in any case of nephritis well-marked symptoms of uremia develop, very energetic treatment is needed, including free sweating with hot packs and vapor baths or hot-air baths and free purgation. To effect the latter powerful drugs are sometimes needed, such as croton oil or elaterium. Neither of these is suitable in childhood.

In most cases where the nephritis is becoming subacute or chronic, there is a tendency for anemia to develop and for more or less dropsy to continue. Here a combination of iron with a diuretic is useful, and Basham's mixture answers satisfactorily. Digitalis is often required to aid an overtaxed heart, and nitroglycerin may lessen the high arterial tension. Hot baths or packs or the vapor bath or hot-air bath are serviceable in proportion to the degree of dropsy. Such drugs as spartein, diuretin, and theocin are often of great value in this stage. The diet in the chronic form of nephritis should be solely or chiefly of milk, sometimes with the addition of cereal gruels and porridges if the nutrition is not sufficiently maintained. Meats should be avoided.

During convalescence from scarlatinal nephritis the greatest precautions must be taken against undue exercise and chilling of the body. The patient should not be allowed to leave the bed until the albuminuria has become very slight, if not entirely absent; and while in bed should always be warmly covered to favor continued action of the skin. When allowed to be out of bed he should be warmly clad, and the transit to the outside air made only on dry, warm, and still days, if the season permits. If possible, temporary sojourn in some warm, salubrious region is to be sought.

Respiratory Complications and Sequels.—These are less common than some other complicating conditions. Bronchopneumonia and croupous pneumonia are not infrequent sequels. The former is most likely to develop at the end of grave septic cases. Serous and purulent pleuritis

effusions of an inflammatory nature are not uncommon. The treatment of any of them is that of the same condition due to other causes.

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CHAPTER VII

MEASLES

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In the study of this disease, for its prevention and treatment, we are immediately confronted with the fact that the cause of measles has not been found. Indeed, this is the case in all the diseases which belong to the group of exanthemata. It is true that in 1908 D. Pacchioni and D. Francioni (10) have again taken up the bacterial quest in measles, which has led to some curious statements: I. In normal cases bacteria are not found in the blood. II. There is a hemophilic bacterium resembling that of Pfeiffer, which is found in the nose, the conjunctiva, and the respiratory mucus. III. Measles is a local infection with general symptoms, the latter probably produced by the critical formation of antibodies. IV. This can be proven only by the discovery of their antibodies. V. The opsonic index of Pfeiffer's hemolytic bacillus is increased, especially after the disappearance of the eruption. The sum and substance of this research is that there is found a bacterium only in the secretions, and, secondly, that the opsonic index of this bacterium is increased. It is unnecessary to point out that this is not sufficient to prove that there is a connection between measles and the bacteria. Lorey (9) has studied the bacteriology of the disease from another point of view, a view which may serve a purpose in therapy. He states that the erysipelas streptococcus is the most common cause of complications; that the intensity of the epidemic is determined by the frequency of secondary affections produced by this streptococcus, which when found in the blood is always followed by a fatal issue; and its presence in large numbers in the tonsils should always be looked upon as a bad prognostic sign. Pseudocroup, this author states, seems to be due to a pneumococcus infection.

As far as the discovery of the cause is concerned, no progress has been made since the days of Howe of Edinburgh, in 1759, who decided that the virus exists in the blood, and this fact, after having been verified by a large number of physicians, has been finally accepted definitively, because of the experiments of Hektoen (7), in which all precautions required by modern science were fulfilled.

For prevention and treatment of measles, then, as far as absolutely precise and accurate measures are concerned, we are still very imperfectly informed. We must, then, depend upon such scientific facts as can be brought to bear upon the subject more or less directly from our study of other infections, and especially upon clinical experience. It is true that, with the enormous progress made in medicine, the great advance in prevention and treatment of disease has been, in a measure, reflected upon the class of diseases now under discussion. Even with all this, the views expressed are largely the result of the experience of individuals, in different climates, upon different races, under diverse external and internal conditions, and in different and differing epidemics. When these various factors are considered, it seems strange that relatively so little divergence exists among the various authors who have written upon the subject. A study of the literature strengthens one in the view that differences of opinion are becoming less frequent and less marked.

PROPHYLAXIS

In measles we find ourselves in the strange position of discussing the proposition whether, during an epidemic, children should be protected or not. The statement that nearly every human being is susceptible to measles is accepted on all hands. During the first five months of life there are few cases; the fact exists and its causes are well worth looking into. Immunity can be explained in three ways only: either there is lack of predisposition, or there is increased resistance, or there is less chance of exposure.

According to my own experience the latter explanation is the one to be considered as the most common cause of exemption of very young babies from this class of diseases. If this is true infants should also be protected.

The next statements which follow are: I. As measles are bound to come, why should the laws of nature be counteracted by preventing exposure of all children? II. Why not expose them in this epidemic, as the next one may be more severe? III. Why not let children have the disease, as measles are so much more dangerous in adults? IV. Why attempt prevention when it is impossible in this disease? Finally it is stated that one attack of measles practically excludes another.

These questions are easily answered. For the first two the answer is simple: it is the bounden duty of the physician to prevent disease and mortality. And this refers not only to the mass of patients, but to the individual patient as well. Certainly no prophylactic measures should be neglected in a disease which causes a mortality ranging from 2 to 10 per cent. and over. If to this mortality from the disease there be added

the mortality of its sequelæ, the percentage of deaths would be much higher.

The answer to III, that measles are more dangerous in the adult, is as follows: It is inconceivable a priori that the mortality should be greater after 16 years of age than before, as the complications of measles, which determine the death rate, are more frequent and more dangerous in the child than in the adult. It may be stated that this question might be satisfactorily settled by a statistical research. But it will not do to draw conclusions which do not consider the same kind of material. It is manifestly an error to compare the mortality among unprotected people with that in those protected by ancestral infections; in civilized and uncivilized people, as shown in the epidemics in the Fardi Islands. In the "Medical History of the Rebellion," pages 659 et seq., this is very well shown, city troops having less morbidity and mortality than those from the country. The most convincing statistics, indeed the only satisfactory ones which directly compare child and adult mortality in measles, are those of Fürbinger (5), in his article on Measles. He compares the mortality of measles in children with that in the adult, the material being the same in every respect and the result being that in children the mortality was 8.1 per cent., in adults 1.3 per cent. Moreover, large statistics show that the highest mortality from measles occurs during the second year of life; next comes the second half of the first year; it sinks to a minimum between the 7th and 10th years of life. So that the argument for exposure of children in order to prevent adult fatality falls to the ground, and danger from measles is less in the adult than in children.

IV. Prevention of measles is impossible. Prevention of any disease is possible only when the physician knows its natural history. At present, this being considered, the statement may be made without fear of contradiction that the spread of measles can be prevented either in hospital or private practice. For the hospital the difficulties are greater than for private practice. This refers principally to those hospitals in which, for one reason or another, prompt and complete segregation is impossible. The appointment of medical inspectors of schools has done much to reduce morbidity in the acute exanthems. The importance of these examinations is very great in measles, but it may be added that physicians should study these subjects before assuming the responsibility of this task.

The statement has been made categorically that a second attack of measles is rare, if it occurs at all. Indeed, some authors do not hesitate to say that when a second attack of measles is diagnosticated either the first or the second diagnosis was wrong. O. Heubner (8) speaks of permanent immunity following one attack of measles, and he says: "Unquestionably measles has sometimes occurred several times in the same

individual, but this belongs to the greatest rarities and does not vitiate the rule." J. Schwalbe (11) says: "Repeated infection of one individual, even twice or three times, is positive, but very rare; however, not so rare as many authors believe it to be." Grancher (6) is also a little less positive than Heubner: "Most frequently one attack of measles is followed by permanent acquired immunity." It is needless to multiply quotations; when medical academicians write upon this subject second attacks are extremely rare or due to error of diagnosis. The same may be said of those whose practical experience is limited to hospitals. On the other hand, the experience of those exercising general practice will be found to reject the rarity of second attacks of measles.

For myself, I have arrived at the conclusion that, of all the acute exanthemata, measles is the one in which second attacks occur most frequently. This view is the result of careful observation of individuals and individual families, which has continued for many years, so that this question, as well as many other questions, could be studied as is possible only under such circumstances.

If, in addition, we add that not only are we risking a patient's life by exposing him to contagion, but, furthermore, that we are taking the chances of complications and sequelæ much more to be dreaded than the attack itself, it will be readily understood that, in the present status of our knowledge of measles, voluntary or compulsory exposure should not be countenanced nor recommended.

Prophylactic measures should be instituted as early as possible, mindful that the cause of measles has not been discovered, and that, therefore, we may consider a manifestation as essential when this is not the case.

We submit the following, which can be applied to the prophylaxis of measles:

I. *The disease is not transmissible during the period of incubation.* This proposition is accepted by all. Practically a difficulty may present itself in rare instances, viz., to determine when the period of incubation ends, and the period of invasion begins. In healthy and normal children the period of incubation of normal measles is not accompanied by any disturbance of health. It is thoroughly understood that a certain class of children complain of the least disturbance or are very easily affected by the slightest somatic alteration. But, with all this and the possibility of the presence of a coexisting disease, when all the symptoms of the period of invasion are looked for, a mistake as to the beginning of this period will rarely be possible. There are two exceptions to this statement, and both usually, if not always, occur during the beginning of an epidemic: the first, that the physician does not consider the possibility of the presence of measles, and the second, that, in an abnormal case, the invasion with all its manifestations is also abnormal.

II. *The disease is contagious during the period of invasion.* The

present view, which has been established positively by many observations and many observers, is that not only is the disease contagious during this period, but that it is most contagious. Grancher claims, as is done for all the acute exanthemata by some members of the Munich school, that contagion exists only during this period of the disease. This has been absolutely disproven by the experiments of Hektoen, which show that the blood is infective thirty hours after the appearance of the eruption. John F. Anderson and Joseph Goldberger (1) have verified this observation in a measure; the infectivity of monkeys beginning "just before and continuing for about twenty-four hours after the first appearance of the exanthem." However this may be, the fact remains that this period, in one sense, is the most contagious, as the greatest number of cases follow exposure to measles in this stage of the disease. Unless this is understood and accepted, it is futile to try to prevent the spread of the disease, and until this fact was recognized all prophylaxis was a complete failure. Fortunately for us it is that we find most characteristic symptoms during this period; the fever, the enanthem, and the respiratory and ocular symptoms; the minor symptoms not being of great importance for our present purpose. The fever in the average case has two maxima, the second one occurring with the beginning of the eruption. Next in frequency is the step-ladder rise from the beginning to the end of this stage, and, in exceptional cases, an absolutely irregular fever. The other forms of fever in measles need not be considered in this connection. The enanthem is the most important single symptom, both for diagnosis and for prophylaxis. The enanthem is very complex and made up of many manifestations. It comprises Koplik's spots, the appearances upon the uvula, the soft and hard palate, the tongue, the larynx, and the trachea. These may appear very early, either the Kopliks or the enanthem upon the soft palate being the first, from three to five days before the eruption, and are indispensable for diagnosis of the disease when segregation does the most good. The blue tongue of measles has been singularly overlooked by clinicians; it develops as early as the second day of the period of invasion, usually later, and is characterized not only by its dusky bluish tint, but as well by its varnish-like, whitish coating, with more or less free edges. This dusky color may be found upon any of the mucous membranes, but develops first in the mouth, the larynx, and the trachea. Symptoms are developed in the eyes, the nose, the larynx, the trachea, and the bronchial tubes. These are more or less intense.

In the great majority of instances we find a sufficient number of signs and symptoms in this stage to warrant a diagnosis, certainly sufficiently positive to warrant isolation until there is no doubt as to the disease being measles or not. In very exceptional instances the diagnosis cannot be made during the period of invasion. Either as it is in the

beginning of an epidemic the examination is not made with sufficient thoroughness, or the symptoms are vague, the period of invasion being very short, or all the symptoms are not only vague, but absolutely not characteristic. We certainly find the enanthem rudimentary in a large number of cases in some epidemics. As for the individual differences, they are so many that they need only be hinted at. When these are observed in the course of an epidemic, little harm is done, but in the beginning, and on account of them, epidemics may be started, which otherwise would not develop. Anomalous conditions, which consist of rudimentary manifestations, rudimentary symptom combinations or their complete absence, are referred to here. In the present state of our knowledge, even when there is but a suspicion of measles in the period of invasion, the patient should be isolated.

III. *Measles is contagious during the stage of eruption.* This has been definitely settled by Hektoen and Anderson and Goldberger (v. supra); and it has also been shown that the infectivity of the blood lasts but a short time—thirty hours. Seigert (13) claims that, after the third or fourth day of the eruption, no contagion exists. The more the disease is studied the more do we come to the conclusion that this statement is approximately correct; in other words, there is contagion during this period which becomes less and less until desquamation begins, i. e., from seven to ten days after the onset of symptoms.

IV. *There is no contagion during the period of desquamation.* This is being accepted very generally. On the other hand, there is no absolute proof aside from clinical observation. v. Kerschensteiner, who first proposed this view for scarlatina, has also applied it to measles.

While I cannot accept it for scarlatina, my experience forces me to admit its truth in measles. I should not, however, be willing to disregard the experience of so many excellent clinicians who believe that contagion exists in this stage. The whole question of desquamation in measles should be studied anew, as we are constantly being misled by the descriptions in most of our text books. But in order to be on the safe side of prophylaxis, it is well to have the patient isolated until desquamation is completed. As this process varies so much as to duration, being a very short process in the majority of cases, the rule can be followed that in normal cases of measles *the patient is no longer infective fourteen days after the first symptoms of the disease have developed.* The tendency to accept this as correct is quite general, although the infectivity of the desquamation material is still maintained. There are still excellent observers who state that measles may be contagious as long as four weeks. What with the views just stated and the study of the virus as to its viability and infectivity it would seem that this is untenable. If the clinical experience of many observers is consulted, it will be seen that, if four weeks is found by them to be the period of infectivity, the number of cases is very small and that there is some error in observation.

Having come to definite conclusions as to when measles may be transmitted, it is necessary to consider how this is done. Infective diseases

are transmitted either directly or indirectly from man to man; and the question whether both of these or only one exists is still being discussed for measles. Experience has taught most of us that, if indirect transmission exists at all, it is very rare. It certainly must be confessed that nearly all the experiments which have been made to determine the indirect transmission are not convincing. Especially is this the case when they have been made in hospitals where there are so many unavoidable sources of error, and in a disease which literally exists and is very contagious before the patient complains. My own experience agrees with that of most authors, that direct transmission is the rule. Grancher is one of the few who believe that mediate transmission is the rule. If the statement of Seigert (l. c.) is correct, that the virus of measles does not retain viability for longer than two hours outside of the body, the rarity of indirect and the frequency of direct contagion will be satisfactorily explained.

In the presence of an epidemic, the question of closing the schools must always be considered. Whenever efficient medical examiners are at hand, this should not be done. Indeed, it need not be considered in cities at all, as children out of school will play with each other more than children in school, and infection will take place more frequently. In country districts the obverse holds good and the schools, therefore, should be closed in any epidemic. But it will be very difficult to convince parents that this is necessary in measles. The question has been asked whether the sisters and brothers of children having measles should be allowed to come to school. Under the supervision of the medical school examiner this is permissible; otherwise we are taking risks of spreading the disease. Seigert's rule, that those who have been exposed and who are not protected by a previous attack may go to school for a week, may be followed by dire results.

The difficulties of prophylaxis are very great; many have already been referred to. One naturally expects a hospital to be so constructed that this prophylaxis can be carried out. But, unless especial arrangements exist, it is just in hospitals that prophylaxis breaks down and is followed by the greatest mortality we have in measles. Variot (14) reports that, of the children with measles which were sent to the *dépôt* of Thais, 66 per cent. died. Both the morbidity and the mortality are, I am happy to state, not so great as just cited. Thus, in the *Hôpital des Enfants* in Paris, there was a mortality of 26 per cent. The statement has been made that the mortality from measles does not exceed 2 per cent. in private practice and 6-10 per cent. in hospital practice. The reasons for higher mortality in hospitals are quite evident—worse material and relatively bad sanitation. The unpreparedness of most hospitals for coping with measles infection is the reason why prophylaxis fails there. In order to be successful there should be a personnel sufficiently adequate,

enough observation rooms, and separate wards. The most favorable way of prevention and treatment is the establishment of special hospitals for infectious diseases; but even in general hospitals I have seen measles prevented from spreading, and that under unfavorable circumstances. That this can be done with relatively great regularity there is no doubt.

In private practice prophylaxis depends upon the time the first case is diagnosticated; the earlier, the greater the chance of the disease remaining limited to the one individual. Under all circumstances, certain individuals should receive extra prophylactic care; children under two years of age (because of danger to the respiratory organs); children with a marked tuberculous history, or such with latent or active tuberculosis; weak children, and unprotected adults, for the same reasons. When measles are epidemic individuals whose lives may be endangered by an attack, should be sent away from home to a place where there are no measles, but this should not be done if the individual has already been exposed.

It is thoroughly understood that those in attendance upon measles should not take the chance of carrying the disease to others, although this is a very rare occurrence. If we bear in mind the fact first demonstrated by Sevestre (13) and Bard (2) and referred to above by Seigert, that the virus of measles is destroyed in not to exceed two hours of existence outside of the body, the necessary precaution to prevent infection reduces itself to not coming into contact with such persons who might get measles. In private practice this is not even adhered to by physicians and attendants. Certainly the least that could be asked is that physicians do not visit healthy children immediately after having seen measles, because of the possibility of carrying the disease. There is no necessity for changing clothes, or putting on gloves and caps, or applying those methods which are imperative in scarlatina, diphtheria, variola, and other more infectious diseases. But we owe it to our patients not to take chances, so that until it is definitely settled that mediate contagion can take place only as described above, precautions against this should be taken.

As to the disinfection of the room, that is a question easily disposed of. All the doors and windows are opened, everything that has come into contact with the patient is exposed and uncovered, and this may be continued for from six to twelve hours. Disinfectants are not required, unless for complicating bacteria. Employing the same precautions, such as formaldehyde, repapering, destroying articles worn by the patient, as is done in other diseases, is not only unnecessary, but futile, in measles.

TREATMENT

Hygienic Treatment.—Every case of measles requires hygienic treatment, and few require anything more. It would be very interesting to collect the popular notions and superstitions which exist in various

countries and with various peoples in regard to the proper treatment of measles. In civilized people this would center around that ubiquitous fetich, the "catching cold" disease; and, all the world over, omission and commission are due to the senseless worship of this superannuated idol. The present era is doing away with much that is unnecessary or harmful, thanks to increase in knowledge of infections; but much still remains to be done. Nothing seems to be more rigidly adhered to in medicine than some custom or precaution which, when traced to its source, will be found to have originated in a medical tenet of a remote medical period, and which is no longer accepted by anyone. Medically speaking, we are then suffering for the sins of our forefathers.

The room in which the patient is placed should be chosen in such a way that the attendants may be kept from other inhabitants of the house as much as possible. Preferably, it should be on the top floor of the house, it should be large, well ventilated, and within easy reach of bath room and water closets. The room need not be stripped of its furnishings, neither need closets be emptied; indeed, none of those other precautions are necessary, such as are taken in those diseases, smallpox, scarlatina, and diphtheria, in which the virus remains active for a much longer time than in measles.

Ventilation of the room is of paramount importance; therefore, the best procurable one should be obtained. This implies the best possible with existing physical conditions and the best which is permitted to exist by relatives and friends. With them the ever-present draft of air is looked upon as the most important etiological factor in producing disease. When this theory is carried to extremes, drafts can be found everywhere, with the final results that in measles the air is absolutely excluded from the sick room, as is still the case in many families, and was always the case thirty years ago. It is no wonder that we were taught that the acute exanthemata were characterized by their odor, that of measles resembling the odor of white mice. Whatever we may believe in regard to the danger from drafts, it is not necessary to regard them as indispensable to the fresh-air treatment, especially as they can be prevented so easily by means of screens. When the draft origin of disease is the principal etiological concept, it is easily compromised with, without prejudice to the patient. Under all circumstances the attempt must be made to give fresh air to the patient.

With the introduction of the open-air treatment of diseases, a number of publications have appeared applying it to measles. While the principle is correct, I believe measles patients can be made much more comfortable when treated inside the house, and, moreover, less opposition will be met—which will counterbalance the difference in the effects of the two methods, if there be any. But when no fresh-air treatment can be had in the house, it should be carried out in the open. The effect of this treatment is very satisfactory, both for prophylaxis and for treatment. It is

of special value in measles because the respiratory tract is especially involved and the fresh-air treatment of respiratory diseases is nowadays universally accepted. According to most authors the temperature of the air should be between 60° and 70° F. In winter it is difficult to keep it so high and in summer it is impossible to keep it so low, at least in private practice. For myself, I do not lay much stress upon temperature, being guided by the condition of the patient, his peripheral and general circulation, his temperature, not the least by his comfort or discomfort. Under no condition should the supply of fresh air be altogether cut off, always being mindful of the fact that in winter more respirable air is found in a given quantity than in summer. The air should be as free from dust as possible. It would seem as if especial attention should be paid to this irritating factor, especially when there is already an irritation of the respiratory mucosa. The same may be said of smoke. With many other observers, I have seen severe laryngitis and bronchitis follow a broken stove pipe in the case of one patient, which promptly disappeared when the child was put into the fresh air. Smoke and dust play the same etiological rôle in measles as they do in all other respiratory diseases.

The suggestion has been offered by Vierordt (16) to have moist air in the sick room, especially in winter. It is supposed to be of service because it has an effect upon the dry mucous membrane. It should never be employed when it interferes with the supply of fresh air. There can be no objection to inhalation of vapor when it is indicated for therapeutic purposes, but it is not necessary as a routine method.

In former days it was the custom to keep the measles patient in a dark room; with some it still is the custom. It was claimed that, as the eye was affected in measles, it should have rest by not being exposed to the light. This seemed plausible enough, and, as a matter of fact, we still keep the room dark when it is necessary to do so, the patient being our guide how much light to let in without making him more uncomfortable or giving him pain. The reasons why we do not do it always and in all cases are many; the old idea that the eye trouble comes from the light and not from the disease has been discarded. Very often the patient does not want to have his room darkened. Both the patient and his surroundings can be better cared for in a light than in a dark room; greater cleanliness, therefore, as well in large as in small things, especially as bacteria are killed by light.

The clothing of the patient should be as light and as comfortable as possible. The same may be said for the bed clothing. Because diaphoretics do good in certain cases and certain conditions, continuous diaphoresis has been applied to routine treatment. In summer or in winter the patient is watched by the faithful attendant or the anxious parents lest he uncover himself and be struck by a draught with all its direful consequences. Constant diaphoresis is followed by loss of resistance, which favors infection. Moreover, it does not make for cleanliness, in the medical sense of the word, disregarding altogether the esthetic aspect of the subject.

The patient should be kept clean. In order to do this it is necessary

that he be given a bath every day. This should be hot, warm, or cool, according to individual indications. Physicians hesitate to order baths in a routine way in measles for two reasons: either they do not believe in them, or they are afraid they might be blamed if a complication should develop after a bath. One author consoles himself in this attitude by saying: "Who knows positively whether this may not be true?" Possibly such a one might consent to a sponge bath given the patient in bed. As a rule, a compromise of this sort will be acceptable, so that both the patient and the conscientious physician are satisfied. But it is not only the covering of the body, but the mucous membranes as well, which should be kept clean. The mouth should be frequently washed with a weak solution of bicarbonate of soda or boric acid. In infants and younger children sprays may be employed, applied to the pharynx, gargles being employed in older subjects. Large quantities of water should be employed for gargles, which may contain one of many substances: boric acid, glycerin, sodium bicarbonate, tannic acid. The mouth and pharynx should be examined frequently so that abnormal processes may be discovered early and treated early. The nose should be sprayed with boric acid ($\frac{1}{3}$ per cent.) or menthol in alboline ($\frac{1}{5}$ per cent.). Other remedies that are recommended are camphor, iodine, eucalyptus, and many more. Whatever is done should be directed to loosening and removing the secretion plus antiseptics, which, in the nature of things, should be very mild.

Diet.—The diet in measles is a simple matter, as it is that of all febrile processes; milk, eggs, broths, the simple carbohydrate foods, such as rice, strained oatmeal, ice cream, for the febrile period. When the patient becomes afebrile, a gradual return to the usual diet may take place. There is one thing which should be considered in dieting measles, that, for one reason or another, there is a natural tendency to looseness of the bowels. An irritation of the bowels may lead to enterocolitis, which may become very serious.

Therefore, I have made it a rule never to give measles patients laxative food until the disease is over. I have seen enterocolitis of a very severe type follow improper diet and I have seen patients die from measles-enterocolitis. It is also not safe to employ strong cathartics for the same reason. When the bowels must be emptied by artificial aid either rectal irrigation or mild laxatives such as castor oil, senna, cascara, or the salines should be employed.

Symptomatic Treatment.—We have described the simple or normal form of measles in the foregoing, in which very little or no medicine is required. The medicinal treatment will be described in connection with the symptomatic treatment. As yet there is no specific treatment of this disease, so that in all forms we can treat symptoms only; nevertheless, by this means we not only give relief, but frequently save life. It goes without saying that the most logical mode of treatment is that which removes

the cause of the disease. But, while this is being done, the patient may die of a symptom. As an illustration, in our present case the fever must be treated, although we are ignorant of its cause, as high temperature per se may be followed by a fatal issue. This has been established both by laboratory and clinical research. In the treatment of insolation the cause has been removed frequently before we see the patient, and the only thing which acts as life-saving is the reduction of temperature. It is correct, in a certain sense, that the treatment of fever alone, or, to be more precise, the treatment of one of the febrile manifestations, the temperature, is no longer looked upon in the same way as it was formerly. This is as it should be. At present we treat, when possible, metabolism as well as the symptoms of fever, either one or the other or both, always being mindful of the fact that we may have to employ especial treatment for one symptom when it promises to do enough harm or to endanger life.

The second form of measles is that which, for therapeutic purposes, may be called the *exaggerated form*, in which one or more symptoms, or the general morbid condition, represent exaggerations of the normal. We say that this form is the result of either the introduction of too much or too virulent measles virus; or it is due to diminished resistance, the former usually occurring in epidemics.

The *fever*, including all the nervous manifestations found in children, is best treated by hydrotherapy. When the temperature in the rectum goes to 105° F. a lukewarm bath is given (96-98° F.), and this may become necessary every two hours, day and night. This is a simple measure and not objected to by most parents. When given early enough, it frequently wards off severe nervous symptoms, wakefulness, restlessness, insomnia, delirium, somnolence, and convulsions. When these baths are objected to, sponge baths may be employed, the temperature of the water being taken as low as 75° F., and given every hour or two. A sponge with equal parts of alcohol and water, warm, is even more efficacious and less objectionable, as there is a feeling among laymen that alcohol "closes the pores of the skin" and, therefore, catching cold is impossible. Aside from these, no other hydropathic procedures are necessary in the great majority of cases. One should be mindful of the fact that measles children bear badly baths of low temperature, and collapse frequently follows when they are applied. When they become absolutely indispensable, and this seems to be the case in the worst types of this form of measles, the patient should be stimulated with camphor, caffeine, or ether, depending upon the heart's action, either before, during, or after the bath. In this treatment the temperature of the bath may be gradually reduced, or the patient may be immediately put into the cold bath, the lowest temperature of which need not be less than 60-65° F. In connection with the gradually cooled bath, cold effusions upon the head and neck are frequently employed. They are highly recommended by many excellent observers.

For myself I have used them only in very robust and organically healthy children and not under three years of age. On account of their profound effect on measles metabolism, whether for good or for evil in the individual case, I no longer employ the cooled or the cold baths with or without effusion in measles. It seems paradoxical to speak of a hot bath in connection with the symptom now under discussion. But given a patient on the third or even fourth day of the period of invasion, with a temperature of 105 or 106 deg. F., somnolent, possibly jerky, and no eruption, or a badly developed exanthem coming and disappearing, a hot bath, in my experience, is of more value than anything else. It increases the circulation in the skin, thereby, in all probability, relieving the splanchnic and possibly the cerebral circulation, paralytic on account of the toxic effect upon the vasomotor centers; and the nervous symptoms begin to disappear, the temperature falls, the circulation improves, the skin loses its brittle dryness and the exanthem develops or "comes out." This, as a rule, is the general effect, but the patient still must be watched and the bath or baths may be repeated every two to four hours when necessary.

The "driving in" of the eruption was considered, and is still considered by some, a very serious matter. Hebra was the first to show by experiments in human beings that: I. It was impossible to do this; and II, that all attempts to do so were not followed by any damage to the patients. Under I he included exposure to draughts, sudden exposure to cold for a short or long time, gradual exposure, the local application of cold, and the giving of cold drinks internally. He certainly was one of the first, if not the first, to consider "cold" as an infectious disease, and his studies in measles especially did away with the superstition that measles could be forced in. As a matter of fact, the eruption disappeared because of primary central processes, probably acting upon the vasomotor center, which, when removed, caused the eruption to come out again. This fear of driving in the eruption is the cause of the application of many remedies; the frequent administration of lukewarm drinks (various forms of tea); the keeping of the skin slightly perspiring; care in washing and drying the skin; avoiding bathing; care in changing linen. "After leaving the bed (at least four weeks from the onset of the disease), and a few days after leaving the room, a cleansing bath is given." This from Heubner (l. c.), who evidently is still under the full influence of the catching-cold fable. Certain it is that Heubner's clientèle and his hospital service must differ enormously from ours in this country. However this may be, cleanliness of skin, as far as I know, can only be obtained by washing, and this is as important in measles as in any other disease.

Many ways of applying cold locally are employed in measles: the ice bag, cold applications, cold effusions, the cold douche. Of these the ice bag and the cold applications are the most frequently employed, especially for pains or for local inflammations. The only exception to this rule is found in infants who do not bear cold well.

Medically much can be done for the fever by antipyretics, but there

are objections to this method of treatment which make it the one of second choice. At the time we were preoccupied with treating the temperature, the sense of power we acquired was very grateful, but very soon came the consciousness of not doing anything except to remove a symptom and this is the indication for their administration. There is one exception to this rule: when for one reason or another hydrotherapy cannot be employed, then the antipyretic remedy of choice should be given. The remedies used in treating the fever of measles are the same that are employed in all other febrile diseases; their history is that of the treatment of typhoid fever, which culminated in hydrotherapy. Quinin was probably the first drug to be given in large doses, either, according to Liebermeister, late in the evening and early in the morning, or in divided smaller doses during the twenty-four hours according to the dosimetric rule; up to three years of age one decigram less than the number of years and one centigram for each month of age. The substitutes for quinin, quinin tannate and euquinin, are valuable because they can be more easily administered, the bitter taste being more or less absent, but the dose must be very much increased; for quinin tannate it seems that it contains not to exceed 35 per cent. of quinin; moreover, it has the objection of causing constipation. Euquinin for antifebrile medication should be given in about twice the dose of the other quinin preparations. Salicylic acid and its compounds have also been recommended, especially soda salicylate and aspirin (0.1-0.50 gm., gr. lss-viiss) twice or three times daily. When salicylic acid is given, only those preparations should be prescribed which are made from wintergreen; synthetic salicylic acid may cause very unpleasant and dangerous conditions. Aspirin does the same, but to a less extent. Its great advantage lies in the fact that it enters the small intestine unchanged, thereby preventing irritation of the stomach. There are many other salicylic acid preparations in the market; of these salol, salophen, novaspirin, are those most commonly used. At present salicylic acid is rarely employed as an antipyretic, but occasionally for its peculiar effect upon bacteria and fermentative processes and as a sudorific. Antipyrin (0.5-0.20 gm., gr. vijss-gr. iii or more in a day) is much more commonly employed. Its advantages are that it is relatively safe; it has no bad effect upon the red corpuscles or the hemoglobin; and it may be given hypodermically. The objections to it are that it may produce very profuse sweating and collapse as well as the common untoward effects of this group of drugs. To prevent the latter, caffein preparations are given in combination with it. Salipyrin and pyramidon are the two preparations which are commonly prescribed. The pyramidon is characterized by its slow but prolonged antifebrile effects; it should be given in small doses, every four hours, and, as it is toxic, its action should be carefully watched.

For the latter reason I have never prescribed it in children, although I do employ it in adults. I never prescribe acetanilid itself to children; indeed I never give any of its direct derivatives; phenacetin, lactophenin, exalgin, etc.

Many excellent observers prefer phenacetin to all other remedies belonging to this group, and there is no doubt but that, in the hands of those who are in the habit of administering this drug, it can be safely employed in children. Finally, we must not lose sight of the fact that, in addition to the good effects of this class of drugs already mentioned, they have a decidedly calming effect upon the nervous system as a whole when properly administered.

The *nervous state* which occurs so frequently in measles, being due to specific toxemia, usually with high temperature and culminating in convulsions, requires especial consideration. Hydrotherapy should always be employed (v. supra). Sometimes it may be necessary to give antipyrin hypodermically for its effect upon the temperature as well as upon the nervous system, when the patient cannot swallow. At the same time remedies must be given to fulfill the paramount indication, viz., to stop the convulsions. In mild cases sodium bromid (0.3 gm., gr. v) every two hours may be given. Even when it is necessary to employ stronger remedies, the bromid is valuable to reduce the irritability of the brain and the cord.

In my experience chloral hydrate is the best remedy in this form of convulsion, indeed in most forms of convulsions in children. Aside from the frequency with which convulsions are stopped, it can be given with safety to the youngest children, either by mouth or by the rectum, and it is followed by no untoward results. "In young infants, 0.1 gm.-gr. iss is given by mouth or rectum, and repeated in a short time. John Thomson gives 0.3 gm.-gr. v of chloral hydrate by the rectum to a child of six months, and 0.6 gm.-gr. x to a child aged ten months." We have been taught the relative harmlessness of chloral hydrate in children by Bouchut in the treatment of chorea. I have given 8 gms. a day in this disease to a child 9 years of age, and I would not hesitate to give Thomson's doses whenever I thought it necessary to do so in infantile convulsions. On the other hand, I am not tempted to try morphia hypodermically or otherwise, as is recommended by a number of American pediatricists: I fear the remedy more than the disease and therefore have no experience with it. Moreover, it would seem unnecessary, as chloroform inhalations, which are safe, seem to give us the necessary additional remedy. These may be kept up for days, the convulsions being quieted and the resultant central lesions being prevented.

The treatment of diseases of the nose will be found in Vol. III, Section II. For that of the eyes the reader is referred to works especially devoted to this subject; the same may be said for diseases of the ear.

The cough should be looked upon as a symptom, and treated accordingly. When it is laryngotracheal, cold or Priessnitz applications may be employed. The food should be given warm or cold, warm when the spasmodic element predominates, cold when it is inflammatory. Warm

or cold drinks should be prescribed and warm or cold inhalations used for the same indication. When there is spasmodic croup, the bromids are invaluable (0.3 gr. v. sodium or potassium bromid every two to four hours). For the inflammatory laryngotracheitis inhalations of cold, slightly alkaline solutions may be tried in the first stage, to be followed by warm ones, either normal salt solution, mildly alkaline solutions with a small quantity of some antiseptic such as eucalyptus, menthol, creosote, the boric acid preparations, or any harmless antiseptic which happens to be in vogue. For the internal treatment of the cough it may become necessary to give codein or opium, with extreme caution in infants; never when there is bronchitis, and in older children only when the inflammation does not extend beyond the large bronchi, on account of danger in producing pneumonia. Antipyrin, belladonna, quinin are especially valuable when there is a tendency to spasmodic attacks of coughing.

We have no specific treatment for the bronchitis of measles. In a routine way I always give an expectorant in the following form: \mathcal{R} Infus. Ipecacuanhæ 0.05-0.10 (gr. ss-1) ad. 75.00 (3iss). Ammonii chloridi 0.30-1.00 (gr. ij-j-x); syrupi tolu-tani 25.00 (3ss). S. One teaspoonful every hour or two. This is the dry stage. Senega may be substituted for the ipecac in the above prescription when the expectoration is loosening (1-2.00 c. c. of the fluid extract).

When in bronchitis crepitant or subcrepitant râles are heard it is wiser, for therapeutic purposes at least, to refrain from splitting hairs as to the existence and identity of a capillary bronchitis with or without pneumonia. This form of disease will be considered under the heading of the complicated form of measles.

The form of measles in which there seems less resistance to a given quantity of measles intoxication represents what has been called the "asthenic" form. It is characterized by general lack of strength, especially by heart weakness, great diminution in vascular tonus, irregular eruption, atypical fever course, and a tendency to complications due either to infection or to cardiac weakness. The therapeutic problem is a difficult one and the result of treatment is not very encouraging. The child should be kept as quiet as possible, concentrated food of high caloric value should be given, alcohol is valuable as a food, even as a temporary stimulant, but it should be given sparingly, both on account of its bad effects upon the heart as well as its depressing of the vasomotors. I should not like to be without alcohol as a stimulant in heart disease or for general debility, but stimulating doses alone should be employed for this purpose. Vasomotor and cardiac paresis is best relieved by adrenalin, caffeine, or camphor. Adrenalin is especially valuable when the splanchnic area is involved, given by hypodermoclysis 1.00 c. c. 1:1000 solution in 1 liter of 0.6 per cent. NaCl. One of the double salts of caffeine, the soda benzoate or the soda salicylate, should be given as soon as the condition

produced is recognized, because of its effect upon the heart and the blood vessels. The adult dose is 0.10-0.20 gm. given hypodermically, not more than 0.40 gm. in a day. For emergencies camphor oil (℞. camphoræ, 1.50 gm.; olei olivarum, 6.00; atheris, 4.00) may be injected, 1.00 c. c. as a dose. For children the usual posological calculation indicates the dosage.

In this form hot baths are preferable to any other for hydrotherapy. At all events one should begin with them and gradually reduce their temperature as seems necessary and advisable.

All depressing drugs should be avoided as a routine practice, especially the acetanilid and antipyrin groups, but emergencies may arise when they may become invaluable. But, do what we may, this form of measles is followed by an enormous mortality, notwithstanding constant care and attention, which are absolutely necessary for good results. As cardiac collapse may occur upon the least provocation, indeed, without any external provocation, it is necessary that these patients should be watched by trained attendants day and night.

Hemorrhagic Form of Measles.—The hemorrhagic form of measles presents itself as two apparently distinct morbid entities. The first, in which the eruption is represented by papules into which capillary bleeding has taken place, or the capillary bleeding into the skin may be more extensive. Because of the fear of "black measles," altogether justifiable, this form may cause great anxiety. According to my experience, it is found especially in children in which slight pressure, at least pressure which is slight for normal skins, is followed by ecchymoses. Whether change in the blood exists has not been determined. The measles run a normal course in this form, absolutely unaffected by the peculiar skin manifestation, and the individual prognosis is neither better nor worse with or without it. The other form of hemorrhagic measles, which usually is fatal, is altogether a different medical problem. The general treatment is that described in connection with the other forms. It is generally accepted that the blood itself is affected, probably as the result of some bacterial invasion or toxemia (one or both). However this may be, our therapeutic indications are easily formulated: I. The treatment of local hemorrhage. II. The treatment of the abnormal blood condition. Both should be attempted at the same time in order to get results. The treatment of hemorrhage is conducted on the latter plan. Locally, pressure is applied when possible in the nose, upon the gums; cold or heat is applied. Cold in the form of the ice bag, the direct application of ice; heat, which seems to be more serviceable than cold, in the form of douches of hot water (as hot as can be borne by the patient, above 110° F.). The astringents are also still applied, tannic, gallic acids, ferric chlorid, and others. They are of value in mucous membrane hemorrhage only when applied directly. Two modern local remedies stand out as being most

serviceable for the local control of hemorrhage. Gelatin in one to two per cent. aqueous solution, thoroughly sterilized, may be injected into the nasal cavity or locally, wherever there may be bleeding; it is claimed that it is also serviceable in gastrointestinal and uterine hemorrhages. When given by the mouth, 30 c. c. or more of a 2 per cent. solution is given; for direct application by tampons 5-25 per cent. solution is employed in uterine hemorrhage. Aside from the danger of tetanus, which should always be considered and guarded against, when applied locally it is not as efficient as adrenalin. This agent may be applied as a spray, or directly, and the effect, every time I see it, becomes more and more astonishing.

I have also found it most valuable in gastric hemorrhage, stomach lavage with 1 c. c. of 1 to 1,000 solution in 1 liter of warm 0.6 per cent. NaCl solution.

For general medication many remedies have been suggested and applied; all the so-called hemostatics have been employed and are still in use. The astringents are still prescribed for this purpose, especially lead acetate, gallic and tannic acids, and some of the iron preparations. It must, however, be remembered that this class of drugs acts entirely upon peripheral blood vessels, and by producing insoluble albumin combinations which tend to check the hemorrhage. Their direct action is all that can be expected, so that when they are prescribed, it should be in such a form that the drug can produce this direct effect. In the hemorrhagic form of measles they might, then, be useful in bleeding from the gastrointestinal tract. Turpentine is also recommended. How it acts is not known. More favorable results may be expected from the calcium preparations, the use of which in hemorrhage we owe to A. E. Wright. The calcium ion seems to increase the coagulability of the blood, and acts in this way to control the bleeding. To make the indication more absolute, it is only necessary to test the coagulability of the blood before giving the drug. But even when the coagulability is not diminished I give it, as in my experience it has been followed by such excellent results. It is administered in aqueous solution either as the chlorid or the lactate of calcium in large doses, from 1.00 gm. every four hours to 1.00 gm. or more every hour or two. Lime water is also given, but it is not so effective as the salts. Adrenalin is a most valuable remedy; when given hypodermically or intravenously it should be diluted by the addition of normal salt solution. As much as 1 c. c. of the 1:1,000 solution may be given to begin with for hypodermic use, and the effects are not only quickly obtained, but thoroughly as well. For intravenous injection not more than 0.2 cm. should be taken as an initial dose. A two per cent. solution of gelatin, of which 200 c. c. are injected into the lumbar region, has been successfully employed in hemorrhagic variola. If it is true that there is lack of coagulability, plain horse serum, antistreptococcus, or diphtheritic

serum should be injected, as the serum contains some substance lacking in the blood of the patient affected, and thus the trouble is controlled. Moreover, the serum might act causatively, as in many of these cases there is sepsis. For purely theoretical reasons, ergot is no longer so freely employed for hemostatic purposes as formerly. It were better that clinical experience were consulted more frequently before conclusions derived from observations upon lower animals are considered as final. Especially is this the case when laboratory and bedside observations do not agree. While ergot is no longer the most important remedy in internal bleeding, it may be employed to advantage, especially in hemoptysis. A good preparation, of which there are several in this country, should be insisted upon. It is administered best as the fluid extract (2.0-4.0 c. c.—5ss-j) by the mouth. Hypodermically it may be given as one of the many preparations called ergotin, but it is only with great care that abscesses are prevented. Ergotol, an unofficial preparation, is absolutely reliable and efficient, according to my experience.

COMPLICATIONS

The complicated form may be described as that in which some other invasion, either general or local, takes place, forming either a clinical addition to the ordinary measles picture, or more or less changing it entirely. Some of these conditions are due to exaggeration of morbidity which belong to the normal picture of measles. Others are due to additional infections, most of which have no possible connection with measles except that measles may have lowered the resistance.

1. Complications from Diseases of Mucous Membranes.—They are found in *the eyes* as conjunctivitis, diseases of the cornea, and the iris; both the latter are rare. These are most successfully treated by specialists.

2. Complications in the Nose and Pharynx.—Complications in the nose and the pharynx should also be treated locally and also preferably by one with special training. But here it is admissible that this may be omitted, as usually the topical application of remedies can be carried out without special training. It consists in employing various remedies in the form of sprays, powders which are insufflated, or solutions which are instilled or injected into the nose. Solutions are made in water or liquid albolene. The following remedies are applied: as powders, bismuth, boric acid, alum, aristol, soziodol, menthol with acacia, with or without equal parts of bicarbonate of soda, as excipient; for sprays, instillations or injections, potassium permanganate, 1:3,000; thymol, $\frac{1}{2}$ per cent. (Heubner), for instillations only; eucalyptus, menthol, and all the milder astringents. The eustachian tube must be kept open and the pharynx should be treated by topical applications. It is of enormous importance that otitis media is prevented, and, if it can be done at all, it is only by

constantly watching the patient's symptoms and by repeated examinations. Certain it is that with the first appearance of fluid in the middle ear paracentesis tympani should be done and without waste of time. Many a time further damage is avoided by this simple operation. For this and the further treatment of otitis media acuta the reader is referred to the proper authorities.

3. Complications in the Mouth.—They are, in measles, stomatitis aphthosa, stomatitis ulcerosa, and stomatitis gangrenosa. The prophylaxis has already been described (v. supra). In all of these prompt and early action is required. The first two are not uncommon, especially the ulcerative form, and prompt treatment is essential (v. chapter on Diseases of the Mouth). In reality this is the form which gives the practitioner more trouble than the others. For stomatitis gangrenosa (noma) the earlier the tissue which is affected is burnt away with the actual cautery the better the results. In this country at least noma or cancrum oris is a very rare occurrence, and must be looked upon as such in its relation to treatment, diagnosis, and prognosis. For the treatment the reader is referred to Vol. III, Section I, Chapter I.

4. Laryngeal Complications.—There are two forms of membranous croup and both of them are found in measles: the *non-diphtheritic* and the *diphtheritic*. This view is not only confirmed by large clinical experience, but by etiological investigations as well. The cause of the non-diphtheritic croup is the streptococcus family, including pneumococcus, which Lorey (l. c.) considers as the cause of this disease. It is never the Loeffler bacillus, although mixed forms occur which should be considered in the treatment of this affection. External applications, Priessnitz, ice bags, even warm applications have been recommended. Inhalations of alkalis, bicarbonate of soda, lime water, or of a normal saline solution or water are used—they may give much relief, but when alkalis are employed, not too much can be expected of them by way of chemical solution of the membrane, the indication which they were expected to fulfill originally. The old-fashioned croup kettle, by means of which the air of the room is charged with steam, is of great value in some cases, of much more value in non-membranous or false croup.

While I can conceive of the necessity of employing an emetic the occasion has rarely arrived in my experience. Is it too much to ask of those who prescribe emetics wherever there is a croupy cough that they employ direct and not indirect emetics? Or their simplest emetic procedures? Aside from the fact that I have seen tartar emetic poisoning, in one instance fatal, follow its administration in non-membranous croup; when there is membranous croup we do not want to reduce the patient's resistance or increase his vulnerability to infection by depressing measures.

When there is any doubt of the non-diphtheritic nature of the affection, a large dose of diphtheria antitoxin should be injected. In prac-

tice this is usually done; certainly this is true of those cases which are becoming more common within the last five years, in which bacteriologic examination gives negative result, and the symptoms are those which are usually taught as characteristic for diphtheritic croup. The doctrine of the unity of membranous croup is still adhered to by notable medical authors, usually by those who do not see many cases in which the Loeffler bacillus is absent. The dyspnea must be relieved; this cannot be done by any remedy which acts by removing it; therefore mechanical means should be employed, intubation or tracheotomy. Intubation should be first tried; if not successful, then tracheotomy should be performed. In my experience with this form of croup, intubation and tracheotomy are not so successful as in the purely diphtheritic form, possibly because we have no means of causing the membrane to disappear as in true diphtheria. In the *diphtheritic croup* treatment depends for its success upon the time when antitoxin is given and the proper dosage. 1,500 to 3,000 units, depending upon the age of the patient, to be given as soon as possible and to be repeated in 12 hours if the symptoms do not improve. If necessary large doses and earlier repetition may become imperative. In measles we have a form of *laryngitis* (croup) which is accompanied by submucous hemorrhage and edema of the larynx and the upper part of the trachea, sometimes extending lower, and not infrequently with ulceration. It is the most fatal of the respiratory complications in measles. In the cases of this rare disease which I have seen, intubation and tracheotomy were of no avail. It would seem that adrenalin might be employed advantageously. The ordinary *edema of the larynx* is treated by inhalations of aqueous vapor, of adrenalin, and early scarification.

5. Bronchopneumonia.—This is the most common complication of measles and the high mortality, especially in institutions, is principally due to bronchopneumonia. This is a fact of enormous importance, as it shows us how, by hygienic prophylaxis and treatment, this mortality may be reduced. Variot's report of a mortality of 66 per cent. is again referred to. On the other hand, Mlle. Corantevete (3) states that 26 per cent. of the children who contracted measles in the Children's Hospital died. While there is a very great difference between the two institutions, 26 per cent. mortality cannot be looked upon as a triumph, when a German hospital reports a mortality of 20 per cent. as early as 1886, although it must be admitted that this is an exception in Germany, where most hospitals show the relatively high mortality which we are in the habit of finding in institutions. Variot does not hesitate to state that bad sanitation and hygiene are the cause, and the sooner this is accepted as a fact the sooner will the relatively enormous institutional mortality be reduced. The fact must be borne in mind that the lower in the social scale we go the greater the measles mortality, measles in this respect differing from scarlatina. This alone would show that

external conditions play a most important rôle in this disease. There must then be reform in those institutions in which measles are treated, and this applies, as far as is observable, to institutions in all countries. The least that can be expected is that the mortality in institutions does not exceed the average in private practice. The time should not be far distant when this result is obtained. The principles that have reduced the mortality in lying-in asylums and surgical wards so successfully apply here. The ordinary method applied to the treatment of this disease in other conditions should also be applied here. There will at times be some difficulty in carrying out the fresh-air treatment in measles. Among those in whom contact with fresh air in measles is an obsession, it is almost impossible to apply it at all. Sometimes when the case is going from bad to worse the family will permit a trial of fresh air, and it is a pitiful sight to see a mother struggling with her convictions and her observation. I have frequently seen a mother open a window when her child became more cyanosed and the number of respirations became increased, and, as soon as these symptoms improved, again close the window, and continue thus for hours and hours. Usually observation wins the day. Oxygen inhalations do not take the place of the fresh air, but they are valuable especially for stimulating the fagged respiratory center. Fresh air does this to a less degree, but by its presence the metabolic bodies of ordinary respiration as well as those of pneumonia are removed. A patient may, therefore, get plenty of oxygen and not have fresh air—indeed, have just the opposite. The beneficial results of the fresh-air treatment are so evident that when once applied there is usually no further trouble. Certainly the patient will insist upon its continuance.

External applications are quite generally recommended in this disease, especially in the form of Priessnitz and poultices. The fine distinctions between the action of heat applied in one form or another, or of cold, have never appealed to me. On the other hand, the question of counterirritation is of the greatest importance. It is rarely necessary to employ active counterirritation; as a rule, the bland external applications in use counterirritate sufficiently by their continuous action upon the skin. Indeed, we defeat our purpose when we add mustard, turpentine, or stronger counterirritants, because the skin becomes irritated or inflamed and the external application will have to be removed. It is not a question of affirming or denying the value of counterirritation; the consensus of opinion among German writers in regard to the value of mustard packs in suffocative conditions due to bronchitis and bronchopneumonia must be accepted. But they rarely, if ever, are necessary, in my experience. In order to prevent too much irritation of the skin, it should be covered with protecting substances, lanolin, zinc oxid ointment, or dusting powders, wheat starch, oxid of zinc, talcum, bismuth, etc.

The medical treatment is symptomatic, as specific treatment has not

been established. Medicines are given especially for the cough and the heart. The heart, per se, rarely requires especial attention, but the vasomotor center, which is affected by the pneumotoxin, as we have seen in the adynamic form, does. The reader is referred to Vol. III, Section II, Chapter IV, for the treatment of bronchopneumonia.

6. The Bowels.—In measles we find an enterocolitis, at one time the small intestine alone being affected, at other times the large; pathologically, both are usually affected at the same time. Clinically, and especially therapeutically, they may be considered as distinct entities. Prophylaxis has been referred to in its proper place. The treatment of the small intestinal form consists of *diet, rest, and medication*. The patient should be kept in bed because he is under control, and general rest is followed by diminution of peristalsis. It is usually not necessary to keep the patient in bed longer than 24 to 36 hours, but in some cases he must be kept in bed on account of the general as well as the local condition. The *diet* consists of milk, cocoa, barley, rice, eggs, toast, broths (chicken, lamb, beef)—the latter three not to be given if there is fever. In children and infants the diet should be milk, preceded by twenty-four hours of semi-starvation to begin with. It is not necessary to begin the *medical treatment* with a laxative unless there is some special indication for it, such as a loaded colon or the presence in the gastrointestinal tract of some indigestible substance. There is such an outpouring into the intestine in this disease, that further purgation is not necessary. In how far this shall be considered as eliminative, and, therefore, not to be checked, it is difficult to determine, except that the general condition must not be allowed to suffer, and that the possibility exists of extension to the large bowel. As a rule, something should be done, especially in smaller children, to control the number of evacuations. As a rule, opium should not be given immediately, but, if the large discharges preceded by pain continue, it should be prescribed. In infants and children all the precautions should be observed that are necessary to make opium safe in them. Ordinarily large doses of bismuth, with or without some intestinal antiseptic, such as salol, may be given, or some of the vegetable astringents: catechu (gm. 1-2, gr. xv-5ss), tinct. catechu comp. 2-12 c. cm. (5ss-5iii), tannigen (0.5-1.0 gm., gr. viiss-xv), tannalbin (1.0-4.0, gr. xv-5i), all adult doses.

The large intestinal form should be treated as a dysentery. Absolute rest in bed is necessary until the process has come to an end. Warm applications to the bowels are very grateful. According to the fullness of the colon, a cathartic should be given and repeated when the colon again fills up; this is easily determined by percussion and palpation of the abdomen. It is wiser always to begin the treatment of this form of disease with a cathartic, and the most efficient is castor oil in one full dose. By some the salines are preferred; indeed, there is a saline method of treat-

ment in which no other remedies are used. After the bowels are freely moved, then morphin or belladonna should be given in small doses, in order to relieve tenesmus; they may also be administered in the form of suppositories. Injections of cold water or warm sweet oil are very valuable for this symptom. The diet should be very rigid, consisting of *no* milk, except in the form of cocoa or with Mellin's food, eggs, non-irritating carbohydrates, soups, and meats when the fever has disappeared. Quinin tannate, bismuth subgallate, salol, B. naphthol, have all been recommended. After inflammatory symptoms have disappeared, local therapy of the large bowel may be tried. The patient should stay in bed until all symptoms have disappeared.

7. Other Infections.—*Scarlatina*, *vaccinia*, *varicella* are occasionally observed in connection with measles; diphtheria has been referred to above. Especial attention must be given to the treatment of *whooping-cough*, when it occurs simultaneously with measles; not only is this necessary to prevent serious lung troubles, but as well because of its producing a predisposition to tuberculosis, lighting up a latent process or making the existing form run its course more rapidly. It may be justly said, as a rule, that when a child survives whooping-cough and measles his chances for becoming tuberculous are relatively slight. Septicopyemia, which is still frequently overlooked, should always be considered in connection with other infections. It is more than likely that some of the rashes considered as relapsing forms of measles are caused by septicopyemia. The same may be said of arthritis, which is sometimes found with measles, and possibly for some of the deeper deposits of pus in central organs.

8. Lymphatic Glands.—Much difference of opinion exists as to whether these glands are enlarged in normal types of measles or not. There is no doubt, as was first pointed out by C. Gerhardt nearly forty years ago, that normally all the glands enlarge, usually during the period of invasion. This includes all the palpable glands, even to the epitrochlears. It is true they are not so much enlarged as in scarlatina, but, on the other hand, they persist longer. This enlargement does not, contrary to that in scarlatina, frequently result in pus formations. But the enlargement persists and forms a sequela which is very important. When there have been localized processes, the lymph glands connected with the localization become enlarged, and, as will be seen, remain so for a long time.

9. The Genital Organs.—We find the same here as in all the acute exanthemata. In males the manifestations are very rare. In females there is leucorrhea, menorrhagia, interruption of pregnancy either as abortion or as premature birth. Uterine hemorrhages also occur, either large or small.

10. Rarer Complications.—Diseases of the *kidneys* are seldom met with, and the same may be said of diseases of the *heart*. Arrhythmia is

occasionally seen. It is not going wrong to say that, as a rule, these complications are not due to the measles virus itself, but are complications of a complication. In the *nervous system* hemiplegia, paraplegia, meningitis, and brain abscess have been recorded. *Arthritis* and *osteitis* are usually of the septic form. Measles itself produces a simple synovitis which rarely results in pus. For their treatment the reader is referred to the proper chapters.

SEQUELÆ

As a result of the advances in medicine, sequelæ are not so common as formerly. Much of the care so improperly applied in the treatment was the result of erroneous conceptions of their nature and cause. The present generation of physicians still suffers from the sins of their ancestors, and it is difficult to convince the patients that these sins are no longer committed except by those who have not acquired enlightenment. Because of the proper treatment of measles, diseases of the eyes and ears, especially of the former, are no longer looked upon as a probable sequela. Nearly every one of the complications may become a sequel. And some of them must be referred to because of their enormous importance. The enlargement of lymphatic glands is probably of greatest importance; the maxillary, anterior, and posterior cervical, the bronchial, and mesenteric, are especially so. Whatever else is done with patients who have these manifestations, they should be carefully watched by the physician. In a number of cases they can be relieved by proper treatment: by the internal administration of iodine and creosote preparations especially. Pure creosote is given before meals, 0.30-0.60 c. c.-m v-x. Syrup of the iodid of iron, 1-4 c. c.-m xv-5i, after meals. In children creosote should be administered, in doses corresponding to the age, but with the understanding that this dose may be gradually very much increased. When creosote cannot be taken, benzosol as its substitute (0.5 gm., gr. vii, ter in die, children in proportion) may be given with excellent results. These patients also do very well on cod liver oil, provided it is well tolerated, but pure cod liver oil and not its substitutes should be employed. The diet should be of high caloric value, and contain large quantities of fats and carbohydrates, the albumin quantitative requisite not being neglected. The patients should go on the open-air treatment. The general treatment is that of tuberculosis, including a change to a proper climate when necessary. The question whether they should go to a sanatorium must be answered for individual sanatoria and individual cases. Certain it is that, when these patients are looked after early and properly, much may be done for them; when this is not the case active tuberculosis continues in its development, a form very difficult to control in adults, and in children frequently very serious on ac-

count of localization in vital organs. Affection of the bronchial and mesenteric glands requires double watchfulness. The treatment of chronic tuberculosis is discussed in its proper place. The same may be said for chronic bowel trouble. The cardiac arrhythmias should be carefully studied as to their nature, nervous or organic, and treated accordingly.

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CHAPTER VIII
GERMAN MEASLES
(*Rubella*)

F. FORCHHEIMER

PROPHYLAXIS

Some question has arisen as to the necessity of isolating patients who have this disease. It would seem that a disease in which a fatal issue has so rarely been observed would require no isolation. Certain it is that most authors who have described German measles have seen no mortality, and when it has occurred it has been in hospital practice principally. If there is isolation it should be on account of morbidity, and not on account of mortality. While rubella does not spread as rapidly as measles, probably on account of the longer period of invasion, it does present itself as an epidemic disease. The first large epidemic that came under my observation spared neither large nor small, young or old, male or female; the morbidity relatively great, the mortality nil. Most of those affected attended to their vocations, including some physicians who continued to visit their patients. The few that remained in the house were kept there by troublesome eyes which prevented them following their work, general malaise, fever, or cough; and then it was only a few days. At all events not long enough certainly to render themselves free from contagion. Under these circumstances it is not strange that no isolation takes place; when the patient is not sufficiently ill to stay in the house, it is difficult to keep him there except by force or reason. Neither force nor reasoning are required in a disease in which there is practically no danger to life. There is no reason except an economic one; the question is how much the state loses by permitting these patients to go about. The individual gains by attending to his work, the state loses by his spreading the disease. Rubella epidemics are not frequent; a large number of individuals enjoy immunity; predisposition is not so great as in measles, and one attack produces protection to further attacks. Compared with measles, it will be seen that we are dealing with a different problem in rubella prophylaxis. In the former, on account of mortality and sequelæ, strict prophylaxis; in the latter, only exceptional prophylaxis.

laxis. This exception is found in young or old in whom rubella might turn the scales from life to death. If necessary, the patient should remain isolated for two weeks, and until desquamation is completed, according to those authors who touch upon this part of the subject at all. Judging from analogy with measles, the patient would be free from contagion after the first days of the desquamation has set in. Certainly it would be an injustice to carry this out except in so far as the person to be protected should continue to remain away from the patient as much and as far as his relations to him will permit. Until we know more about this whole subject, this seems the fair attitude.

Finally, the difficulty of prevention must be considered. A disease with a long period of incubation, a period of invasion so short that it can be neglected, and with contagiousness as sure as the symptoms appear, can not be easily kept from spreading.

TREATMENT

This is hygienic and medicinal as in measles. As a rule, none is required. For symptomatic treatment the following may be considered: Febrile, gastrointestinal, respiratory, glandular, and nervous manifestations, as described for measles. Nephritis occurs occasionally; I have seen three cases, and it is well to examine the urine before discharging the patient for the sake of precaution. The division of rubella, according to the predominance of a measles or a scarlatinal type of eruption, calling the one rubella morbillosa, and the other *R. scarlatina*, or considering the latter a third disease (Duke), does not interest us as far as treatment is concerned. The treatment of rubella scarlatina (Duke's disease), as well as that of the erythema infectiosum, is purely symptomatic.

CHAPTER IX

MUMPS

JOHN RUHRÄH

Synonyms.—Latin, *cynanche parotidea*, *parotitis epidemica*; French, *les oreillons*; German, *Ziegenpeter*; Spanish, *murria*; Italian, *stranguglioni*.

GENERAL CONSIDERATIONS

Definition.—This is a specific infectious disease characterized by fever, a certain amount of disturbance of the general system, and a swelling of one or more of the salivary glands. As a rule, the swelling is confined to one or both of the parotids. Sometimes the submaxillary or sublingual glands may be involved, together with the parotid, and at other times one or all of these last-named glands may be the only manifestation of the disease. In some instances the pancreas is involved, usually as a complication; but in some cases the disturbance in the pancreas is the only change which may be noted. Diagnosis in these cases, of course, could not be made apart from an epidemic of mumps.

Complications.—There are numerous complications, often but little known, and very puzzling to the general practitioner, both from the standpoint of diagnosis and of treatment. The most frequent of these is the swelling of the testicle and epididymis in the male, and, of less frequency, swelling of the labia majora or of the ovaries in the female. In addition to these there is not infrequent involvement of the mammary gland either in males or females. A complication of less frequent occurrence is the extension of the disease, or, at any rate, of the swelling, to the tonsil and pharynx, to the conjunctiva and tissues above the eye, and to the subcutaneous tissues below the parotid—the swelling in some instances reaching remarkable degrees. Of still less frequent occurrence are the inflammations occurring in the lacrimal glands, in the thyroid, and sometimes in the thymus; and of particular importance is the involvement of various parts of the ear, of the eye, and, occasionally, of the nervous system—chiefly in the form of meningitis.

History.—The disease has been known from the earliest times. Hippocrates has given a most interesting description; and he noted an epidemic occurring in Thasos. He also observed the frequent involvement of the testicle. Since his time the disease has been referred to by various writers, including Galen, Celsus, and Aetius. Its contagiousness was referred to by Mangor in 1773, and Hirsch, in his *Handbuch der historische und geographische Pathologie*, ii, 1864, has given a list of the epidemics of the disease, the first one of which, in America, was described by Chalmers from Charleston, South Carolina, in 1744, and the second one, in the same locality, was described by the same author in 1768.

The disease is more frequent in winter than in summer, and, while it may occur at any age, it is most frequent between the ages of 5 and 15 years. A curious feature of the disease is the fact that *it may recur*; and Catrin has observed this in 6 per cent. of his cases, which is certainly higher than in the experience of most authors. Gerhardt has noted an instance in which the recurrence took place in nineteen days after the original disease had subsided. The course of the recurrence is quite similar to the original attack. It should also be noted that mumps may occur with other diseases.

Mumps is a disease in which comparatively few pathological and bacteriological studies have been made. This is partly due, perhaps, to the difficulty of getting post mortem material, and also partly due to a lack of interest. Notwithstanding this, a number of organisms have been described. One of the most complete studies is that by Laveran and Catrin. They obtained an organism in pure culture by puncturing the parotid gland, also from the testicle, the edematous tissue, and the blood. The organism was a micrococcus occurring in pairs, which grew on ordinary media, and was easily stained with ordinary dyes or decolorized by Gram's method of staining. These results have been confirmed by Darling and others, but perhaps not sufficiently. There have been no satisfactory animal experiments, and no work of any importance upon the use of vaccines or of serum therapy.

Susceptibility.—It is not uninteresting to note that, while the majority of cases occur between the ages of 5 and 15, after 15 years the susceptibility apparently diminishes with age, although individuals of 60 or 70 are not entirely immune. Under 5 years the susceptibility to the disease is not great, and nursing infants, as a rule, are immune, and may even nurse the breast of a woman with mumps without taking the disease. Instances of the disease occurring in nurslings, however, have been reported. White has reported a case of a woman whose child showed signs of the disease six days after delivery, and the woman herself had a swelling of the parotid on the following day. Comby cites a case in which a woman, eight months pregnant, developed mumps, and her child, born at term, showed marked swelling of the parotids and had difficulty in swal-

lowing, which increased for two days, when the swelling gradually disappeared.

Transmission and Infectiousness.—(Of great practical interest are the facts concerning the transmissibility of the disease and the occurrence of epidemics. The disease is one which is apparently contracted by direct contact; and almost all of the cases occur in this way. The disease is evidently transmissible before the symptoms appear. The infectiousness is probably most marked in the beginning of the disease, and may persist, certainly in some instances, as long as six weeks after the disappearance of the symptoms; although usually a patient may be considered safe to associate with others three weeks after the symptoms have disappeared; and doubtless a great many before this period has elapsed. As we have no means at the present time of telling whether a person is capable of transmitting the disease or not, three or four weeks should be allowed to elapse before the individual is permitted to go about, especially if there is any wish to avoid infection of others, as there always should be. In the case of children this is usually easy to secure, but in adults otherwise actively occupied in important affairs such a long period of isolation is scarcely practicable. The disease is not transmitted through the air to any great extent, and, while it is possible for an otherwise healthy person to carry the disease without contracting it himself, this is certainly a very exceptional occurrence. In these instances the virus is apparently carried in the mouth of healthy individuals closely associated with mumps, and may be transmitted by kissing. *Transmission by fomites* is certainly very rare, and almost unknown, although Roth relates a case in which the disease was contracted by sleeping in a bed previously occupied by a patient with mumps. In a disease like mumps it is so difficult to exclude the possibility of infection by direct contact with individuals having, or about to have, or who have recently had, the disease, that evidence as to its transmission by means other than direct contact must be regarded with considerable suspicion. Epidemics in institutions are not infrequent. They may occur in schools, and not infrequently in barracks. The number of people affected varies in different epidemics, and according to the age of the individuals exposed. Usually from one-fourth to one-third of those coming in contact with the disease will take it. *Epidemics in institutions* are usually slow and last several months, new cases developing from time to time; and they are often curiously confined to one part of a building or to one enclosure.

Incubation.—The incubation period is usually long and is variously stated by different observers. The average is from seventeen to twenty-one days. Variations are placed at from three to twenty-five days or longer. The Commission of the Clinical Society of London placed the limit from fourteen to twenty-five days. There have been undoubted cases, however, where the disease developed after thirty-five days (Par-

ker Douglas), and even after six weeks (Bernutz). One attack usually confers immunity. While recurrences are not uncommon, second attacks are more or less rare, but they may occur at times, and even third attacks have been reported.

PROPHYLAXIS

The prophylactic treatment consists in isolation. This is of especial importance in cases of young soldiers and school children. For practical purposes four weeks after the onset of the disease the patient may be allowed to mingle with others. This is an arbitrary rule, but one which certainly will give satisfactory results in most instances. Longer periods of isolation are not advisable on account of the great loss of time; and very few infections take place after this period has expired. It must be remembered that epidemics are often set up or continued by individuals who have been exposed to the disease and who infect others just before the symptoms are manifest, or just after they have begun. Under ordinary conditions these individuals who have been exposed to the disease are disregarded, because it involves a great loss of time, as three or four weeks would have to elapse before the individual could be reasonably sure not to be a source of danger. In schools with medical supervision, if the children are allowed to go to school, they should be under the most careful observation between the second and third week after they have been exposed to the disease. Children who have had the disease previously, and who are living in the house with cases of mumps, may be allowed to attend school. The use of some antiseptic mouth wash in these cases would certainly not be amiss. In the case of barracks all the individuals exposed should, as far as possible, be confined to the same building or group of buildings, and not allowed to mingle with others under ordinary circumstances until the period of incubation is over.

TREATMENT

The treatment of the disease itself is rather simple, although there are complications, at times requiring more or less attention. It is a good rule to *keep the patient in bed* for eight or nine days, and this is of especial importance in the case of young males, as it undoubtedly reduces the tendency to a metastasis in the testicle. The *food* should be liquid, if there is much difficulty in taking it; although any soft or easily swallowed food may be allowed. In some instances the difficulty of opening the mouth is so great that the food must be taken through a tube or a straw. Milk, custards, and egg-nog are the most suitable for this purpose.

It is usually well to give the patient a purge at the outset, some simple saline, sulphate of soda, or phosphate of soda, or magnesium sulphate usually being preferred. If the *temperature* is high, the patient is nervous and uncomfortable in consequence, and the use of ice bags to the head or sponging with tepid or cool water or equal parts of alcohol and water may be resorted to. It is scarcely advisable to administer antipyretics to reduce the fever; although, if the nervous symptoms are marked, as they sometimes are, the administration of antipyretics with or without bromids or codein sulphate may be considered. *Pain* is a very variable symptom, some patients not suffering at all, while others are exceedingly uncomfortable. I believe that antipyrin and codein sulphate in combination will give greater relief from the pain with less general disturbance than any other anodyne that may be used; although there is no objection to the administration of some forms of opium, should the physician prefer it. The after-effects are more marked, however, both in the general discomfort and liability to headache, as well as constipation. The pain may often be controlled by local applications, and various methods have been advised. In some the use of the hot water bag or an electric heater gives great relief, while others prefer the application of cold in the form of an ice bag. Whether one chooses heat or cold depends upon the personal equation of the patient. All things considered, I believe the cold gives more relief in a greater number of cases than heat, and certainly tends to reduce the fever at the same time. The patient who complains of discomfort from the ice bag when it is first put on will frequently ask for it if its use is persisted in long enough for him to get accustomed to it. Of the *local applications* to the gland, 5 per cent. guaiacol is frequently used either with glycerin or rubbed up with an ointment. Belladonna ointment has been found to be effectual in relieving pain, and many physicians use methyl salicylate painted over the gland two or three times a day. Other local applications need hardly be mentioned, although all sorts of things have been advised. In some instances the *swelling of the gland persists*. In these cases *gentle massage* may be advised, using cocoa butter as a lubricant, and having massage done for five or ten minutes twice a day. The use of iodid of potash ointment has been suggested in these cases, but the internal administration of iodid of potassium in five or ten-grain doses three times daily, and in some instances even larger amounts than this, will be found to be more effectual. Where there is marked *anemia*, together with the chronic swelling, the internal administration of the syrup of the iodid of iron is to be advised. *Mouth washes* are usually useful, although sometimes difficult of application. The cleansing of the teeth may be impossible if there is much swelling. Equal parts of peroxid of hydrogen and water, saturated solution of boric acid, and 1 per cent. permanganate of potash are usually recommended. Dobell's solution or Seiler's solution

may be used. Eustace Smith suggests a saturated solution of salol in an ounce of alcohol, to which 40 drops of chloroform have been added. Thirty or forty drops of this solution in a tumbler of warm water will be found to be a pleasant antiseptic wash. In some instances there is *excessive ptyalism*, and this may sometimes be relieved by full doses of atropin. In other cases there is stenosis of the duct, which leads to a dry mouth; Burton has suggested the insertion of a probe into the duct and the use of a constant current in these cases. Sometimes, even when the duct is not stopped up, there is a lack of secretion which leads to a most unpleasant *dryness of the mucous membranes* of the mouth. This may be alleviated to a certain extent by mouth washes containing small amounts of glycerin. In some instances the patients suffer from a lack of fluid, the blood actually getting thicker, as in Asiatic cholera. This may be relieved either by rectal injections of normal salt solution or plain water, or, if that should be contraindicated for any reason, by subcutaneous infusions of salt solution. Where there is *excessive swelling of the uvula or mucous membranes of the throat*, it is sometimes necessary to scarify these tissues with a sharp knife, all except the point of which should be carefully guarded by the use of a bandage. There have been instances in which *edema of the glottis* developed. Where this occurs, tracheotomy promptly done is the only thing which is of any avail. Meningitis should be treated by general measures devised for this disease, and lumbar puncture should be done to relieve pressure.

The question of *suppuration* in mumps is one of considerable importance. The redness and semifluctuation which may be present frequently suggest an abscess when none is present. Inasmuch as suppuration in mumps is exceedingly rare, and frequently suspected where it does not exist, a very good rule is not to incise the gland unless the diagnosis is quite certain. Should suppuration occur, or be suspected, it is a good plan to use a very small-bladed knife, and make a very small incision until the pus is located, when it may be made sufficiently large. Care should be taken not to cut the branches of the facial nerve; consequently the cut should be made in lines radiating from the exit of the facial nerve, and should be kept back of the line drawn from the zygomatic arch to the angle of the jaw.

The treatment of *orchitis* and *epididymitis* is very important. There is atrophy of the testicle in perhaps two-thirds of the cases regardless of the treatment instituted, yet it is quite probable that rest and the proper protection of the gland may have something to do with its conservation. The treatment consists in rest in bed and the proper support for the inflamed gland, which can usually be secured by cushions or cotton. Application of cold is one of the most satisfactory means of controlling pain. Many local applications have been suggested, chief of which are belladonna ointment and guaiacol, as suggested above. Mar-

tin has suggested the injection of 0.01 gram of pilocarpin. This may be repeated every second day. He states that it shortens the course of the inflammation and relieves pain. It is well to bear in mind that the usual course of the disease is from six to nine days, although in some instances it may be prolonged to two weeks or occasionally even longer. If the pain is very severe, anodynes of various kinds may be administered internally. The use of galvanic or faradic electricity has been suggested to prevent atrophy, but the success with which this is attended has never been very satisfactorily demonstrated. The treatment of the involvement of other glands, such as the lacrimal gland, the thyroid, or the thymus, is best carried out by local applications of cold. Nephritis and the other complications are treated on general therapeutic principles.

CHAPTER X

WHOOPIING-COUGH

JOHN RUHRÄH

Synonyms.—Pertussis (Sydenham); tussis convulsia; Kink-cough; chin-cough; French, coqueluche; German, Keuchusten; Spanish, tos ferina; Italian, pertosse.

GENERAL CONSIDERATIONS

Definition.—Whooping-cough is a specific infectious disease, characterized by a paroxysmal or spasmodic cough, usually ending in a long sonorous inspiration and often accompanied by vomiting. The medical writers of ancient times did not describe whooping-cough, certainly not with any clearness, but a disease which is so striking in its symptomatology could scarcely have evaded description. The first epidemic of which we have any record was one which occurred in Paris in 1578, and was fully described by de Baillou. The epidemics of cough previously described by various writers had evidently been influenza. The disease spread to other countries, and Thomas Willis in 1658 mentioned it as occurring in England, and Sydenham in 1679 gave a good description of it. During the eighteenth century the disease was frequently observed, and the best articles of this period are those of Plaz in 1727 and Friedrich Hofman in 1732. During the nineteenth century the disease spread over the remainder of the civilized world, the last countries invaded being New Zealand in 1847 and Australia in 1890. At the present time it is endemic in most of the large cities; and epidemics of more or less severity are so frequent as to attract no attention, and not noted except in special statistical articles.

Etiology.—It should be stated that the disease varies in virulence from year to year, and seems to be more severe and also more frequent in cold climates. It is much less severe in weather which permits children to be out of doors, and epidemics are less apt to happen under such conditions, as people are not crowded together, and so infection is less

frequent. *Almost everybody is susceptible*, and the majority of persons have the disease some time during their life. Infants under six months of age are less susceptible, but there are instances on record in which symptoms of the disease were observed on the first day, a mother in this case having taken care of a child with whooping-cough. Girls are said to be more susceptible than boys, as are also children whose resistance is lessened by having had other infectious diseases, and children who are below the average standard of health. The disease is most frequently seen between six months and five years of age, and over half the cases occur between six months and two years of age. Susceptibility decreases with age, but it may be seen in adult life and even in old people. It is interesting to note the rule that paroxysms are more severe in nervous children than in others, and Wimmer and Meissner are authority for the statement that children deprived of some of their senses, such as the deaf, dumb, and blind, usually have the disease in a mild form.

Various bacilli have been described as the cause of whooping-cough, but a small bacillus described by Bordet and Gengou is probably the organism which produces it. This organism resembles, more or less, some of those which have been described by other authors, and the difference may be due to the difference in technique. In a general way it may be said that the organism resembles the bacillus of influenza, although it may be easily separated from it by agglutination reactions. This bacillus is present in the bronchial mucus during the first few weeks of the disease, and later on is isolated with difficulty, or not at all. This coincides with the general impression of those who have had much to do with the disease, that it is most infectious during the first two weeks.

The *transmission of the disease* is a matter of considerable importance. It is usually transmitted by direct contact, and but a very short exposure is necessary for infection. In some instances the infection seems to take place in the immediate neighborhood of a case, and in these instances it is quite probable that the infection is caused through the small particles of sputum which are sprayed about the child during coughing. The disease is apparently infectious from the beginning of the first symptoms. The infectiousness is probably most marked during the first two weeks, but occasionally it is transmitted later. Transmission by a third person is rare, and whooping-cough carriers have never been described. The disease is not, as a rule, transmitted by fomites, although this may occur. One of the best examples of this is the case of a woman whose two children had whooping-cough, and were on board of a ship which touched at St. Helena. The children of the washerwoman who laundered the children's clothing contracted the disease, there being no other cases of whooping-cough on the island at that time. In hospitals and institutions the disease shows considerable variations in its infectiousness. Where there are a great many children who mingle together closely, or

when the beds are too near each other, or when there is overcrowding generally, epidemics are frequent and usually severe. In well-run institutions, where the air space is sufficient and ventilation good, where the beds are far apart and the children kept separated, the danger of infection is greatly lessened; and, if the sputum is carefully looked after, infection may be avoided altogether. This would seem to prove conclusively that the virus causing the disease is not transmitted through the air except as it may be sprayed in the sputum, or be carried on dust.

Recurrences of the disease are quite rare, although they have been noted. It is almost impossible to state definitely the length of the *period of incubation*, but usually from one to two weeks pass from the time of infection to the onset, while sometimes it would seem that only a few days are all that is necessary. If sixteen days pass and the disease has not made its appearance, the chances are that it will not develop. It is well to remember that the *disease is characterized by three stages*. The first, a prodromal stage or stage of invasion, in which the symptoms do not differ materially from an ordinary bronchitis, except perhaps that the tendency to cough at night is more marked, and that there is usually a marked increase of the small mononuclears. This stage lasts from a week to ten days, or sometimes two weeks. The second, usually called the spasmodic or paroxysmal stage, lasts for a number of weeks, and then the disease passes into the third stage, that of decline, which may last a week or two longer.

There are numerous *complications* of whooping-cough. These are due partly to the toxin of the disease and partly to the severe coughing. Among the most important are hemorrhages, which are probably due to a combination of the above. Bronchitis is always present during the prodromal stage, but should be regarded as a complication if it occurs later. Nine-tenths of the deaths are due to bronchopneumonia. Lobar pneumonia is seen more rarely, and is not as fatal. There are numerous disturbances of the nervous system both during the disease and following it, the most important of which are cerebral hemorrhage with its usual sequelæ.

The *misuse of drugs* in the treatment of the disease is a frequent cause of symptoms which may be erroneously attributed to whooping-cough. The most frequent of these are delirium, dry throat, and dilated pupil, from the use of belladonna or atropin; the tinnitus, gastric disturbances, rashes, and other symptoms from quinin; the drowsiness or even unconsciousness from narcotic drugs; the heart failure, cyanosis, and great prostration due to the coal-tar derivatives.

It should also be noted that the other infectious diseases of childhood are liable to affect children with whooping-cough; and, when met with, are particularly severe. It is also important to call attention to the fact that whooping-cough is a disease in which there is a high mortality, not-

withstanding the fact that the laity and most physicians seem to regard it as a mild disease. It usually causes more deaths than scarlet fever. The older the child the better the prognosis. Nine-tenths of the deaths are due to pneumonia, and among the other causes of death are: inanition, which is usually caused by loss of sleep and constant vomiting; convulsions, hemorrhage into the brain, external hemorrhage, asphyxia, and syncope. Deaths are more common where hygienic surroundings are bad than among the well-to-do.

PROPHYLAXIS

This is a very important subject and one which is practically overlooked by most physicians and by the laity. There is, perhaps, no disease causing the same amount of suffering and the same danger to life as whooping-cough in which there is an equally shocking disregard of the rights and feelings of others. I have known numerous instances where otherwise thoughtful parents had invited healthy children of neighbors in to play with their children who, being ill with pertussis, needed, as they thought, some extra amusement. Some little educational work along this line is very much needed. Of course the reason is not far to see, and it is that the child is able to go about, and instructions are usually given to keep it in the fresh air as much as possible. This leads to the child being taken into crowded street cars, railway trains, and even to places of amusement. The spread of the disease can only be prevented by keeping the child away from other children who have not had the disease, and the doing of this lies with the parents of the child. In every instance it is well to explain the reasons for keeping the child away from others, and to insist upon this being done. Particular stress should be laid upon the avoidance of the infection of young children and of those with other diseases. It should also be borne in mind that there are no measures which will prevent the patient from taking the disease if he is susceptible, except keeping away from individuals who have it. It is quite possible that a method of vaccination will be devised, as noted further on in this article. The patient is to be regarded as a possible source of infection until the paroxysmal stage of the disease has passed, although the earlier stages of the disease are the ones in which particular care should be exercised. Disinfection of the apartments occupied by a whooping-cough child should invariably be undertaken if the rooms are to be occupied either by infants or by young children, especially those in ill health. Under ordinary circumstances, however, disinfection is scarcely necessary, as the organism causing the disease dies of its own accord after a short exposure to the light and air.

TREATMENT

It should be borne in mind that, up to the present time, no remedy has been found which will in any way shorten the duration of whooping-cough; and, while this is true, it may also be emphasized that much can be done to render the suffering from the disease less severe, and also prevent many of the complications.

It is too often regarded by both the laity and physicians as a disease for which nothing can be done; and there are many popular sayings which serve to keep this impression alive, the most pertinent of which is perhaps that of the Bavarian peasants, who say that it lasts until it stops. There is another saying attributed to Franck, "You can kill a whooping-cough child before the affection has run its course, you can never cure him," which has perhaps had a good deal to do with the attitude of the profession in regard to the disease. There is scarcely any ailment which has had as many drugs and other measures suggested for its cure as pertussis; and almost every week sees some new remedy suggested, while the number of nostrums claiming to be specific is legion.

Hygienic Measures.—These are of equal if not of greater importance than medication. The first point to be noted is to keep the child in the *fresh air* as much of the time as possible. A *quiet out-of-door life* is the best; but if, owing to other circumstances, such as inclement weather, this is not possible, the apartments occupied by the child should be thoroughly ventilated and the sleeping room thoroughly aired during the day, and an abundance of fresh air supplied during the night. When the child cannot be out of doors, moving from one room to another is of considerable value, the room which the child occupied being thoroughly aired in the meantime. The second point is to have the child lead a quiet existence, as free from excitement as possible, since anything which tends to arouse the child is liable to bring on severe paroxysms of coughing; fits of anger, which, in the irritable condition accompanying whooping-cough, are all too easily excited, should be carefully avoided. The child should be protected from severe weather, and, when out of doors, should be kept out of the wind as far as is practicable, and especially out of the dust and away from irritating vapors. This is sometimes difficult in the case of city children, who should by preference be sent to the parks or open squares. The *clothing* should be changed with the weather, the proper amount being the smallest number of garments that will keep the child comfortably warm. Care should be taken not to burden the child with extra covering either by day or night. The *temperature of the apartments* occupied by the child should, as far as possible, be kept the same. Sudden exposure to cold may bring on paroxysms, but this is no contraindication to having the child out of doors in cold

weather. If the child's *bed* is in a cold room, it is well to have the sheets warmed before the child is placed in bed, so as to avoid the paroxysm which takes place when the child is placed between cold sheets. While the child should be bathed sufficiently to keep it clean, and in hot weather to keep it comfortable, too much bathing should be avoided. The *psychic treatment* is of considerable value. As far as possible, the child should be taught to restrain any desire to cough, as in some nervous children the number of paroxysms may undoubtedly be influenced in this way. As a rule, the paroxysms come on spontaneously, but it should be borne in mind that, while this is true, they may be easily brought on by a great number of external stimuli. For diagnostic purposes a paroxysm may be excited by pressing the finger or the handle of a spoon over the epiglottis. Sudden fright at times lessens the number of paroxysms, but it may also at other times make them more frequent. Children often start to cough by imitation, so that in institutions where there are a number of whooping-cough children the paroxysms seem to be greater than in the same number of children who are kept apart. Very often a number of children will have a paroxysm brought on apparently by one child starting the cough and the rest feeling impelled to imitate it. Under no circumstances should punishment be used, although there are instances on record in which this has been suggested as a means of treatment. Any measure which will lessen the number of paroxysms should be regarded as of value; as by so doing the danger of complication is considerably lessened. Nägele has suggested a procedure which will often cut short the paroxysm. This consists in pulling the jaw forward and downward in the manner frequently employed by those giving anesthetics. This may be taught to parents and nurses, who may in this way stop a certain number of paroxysms if they are taken in time. This is perfectly practicable, but I have found that, as a matter of fact, it is of very little service, since it is only the exceptional nurse who will take the trouble to keep the child under sufficiently close observation to apply this method in time to be of any service. Another mechanical suggestion, and one of considerable value, is that of Kilmer, of New York, who advocates the use of a tightly fitting *elastic bandage* about the abdomen. This, he claims, will not only lessen the number of paroxysms, but will also lessen the number of times which the child vomits. I can not state positively that, in average cases, it influences either the number or the severity of the paroxysms, but in cases of unusual severity it sometimes seems to do a great deal of good in this direction.

There can be, I think, no doubt as to its value in lessening the amount of vomiting, and, while it is not specific in its action, it affords remarkable relief in some of the most troublesome cases which one is called upon to treat. It also is of some value in lessening the abdominal pain so frequently complained of, due to the frequent attacks of coughing. To be of any service the band must

be properly applied. The best method is to use a stockinet band similar to those used under plaster jackets, this being applied to the body from the axilla to the pubis. It is kept from slipping down by the use of shoulder straps. On this, stockinet elastic webbing, similar to that used in making elastic stockings, is so applied that it covers the abdomen. In applying it should be pinned slightly on the stretch and sewed on to keep it from curling. I have found that any heavy resistant cloth, such as good stout muslin, may be used for making the jacket, and that a strip of webbing five inches wide may be used for the front from top to bottom. The jacket should be opened in the back and secured by lacing. This will enable it to be applied very snugly and the elastic webbing makes very firm and, when properly applied, even pressure over the entire abdomen. Sometimes it is necessary to secure the lower part of the jacket in front by pinning it to the other clothing. Unless this jacket is applied so that pressure is firm and uniform it is of very little service.

Numerous suggestions as regards treatment have been made, and one idea is that *vaccination* for small-pox influences the course of whooping-cough. This was noted soon after the introduction of vaccination, and various observers since have called attention to it. I have had no experience with it, but Poschi advocates its use at the beginning of an epidemic (see also Vaccination). He believes that it has some curative value if done during the period of incubation; but none if the initial stage has begun. To be of any service, it appears that the vaccination must be done at this time, and those in whom vaccination has been done a year previously seem to derive no benefit so far as pertussis is concerned. These interesting observations have been made sufficiently often to warrant a more careful study of the subject to determine the true value, if there be any.

Disinfection of rooms occupied by the patient is a method which is frequently suggested, and Mohn of Norway claims to have shortened the disease by this method. He used sulphur, but formalin disinfection has been tried, and a very dilute formalin vapor is also advocated as a method of treatment.

Breathing compressed air in especially devised chambers also has its supporters. The breathing of the fumes from the lime employed in purifying illuminating gas was formerly in vogue, its chief use probably consisting in getting the little patients out of doors while making the journey to and from the gas works. The injection of antidiphtheritic serum has been suggested, but it has been suggested in so many other diseases in an irrational manner that it deserves no more than passing mention.

Diet.—This is a matter of great importance and, in some instances, of great difficulty. In the milder cases light, nourishing food is all that is required, and no especial restriction except that of indigestible articles is needed. Younger children should be placed either on an exclusive milk diet or a diet composed of milk, cereals, and broths, and the same

should be given where vomiting is frequent. Milk to which 3 grains of sodium citrate has been added to each ounce is useful. It is a very good plan to have the child take as much food as possible during the period of the disease in which there is little vomiting, so that, in case much food is rejected later on, the general condition will not suffer too much. In some cases almost every meal is vomited, and it occasionally happens that the child suffers severely from the lack of nourishment. There are cases on record in which children have occasionally died from starvation. In many of these the feeding is a matter of the greatest difficulty. The best plan is to give the child milk or some easily assimilated liquid food, with the chances that some of it will pass through the stomach quickly, the chance of this being much better than when solid food is given. If one meal is vomited, a second should be given as soon as the stomach is quiet, and it is a good plan to have the meals taken as soon after a paroxysm as possible, as following an attack there is frequently a period of calm during which the food may find its way into the intestine. In all cases where the vomiting is severe rectal feeding may be employed in addition to the above measures, and subcutaneous injections of oil may be of some benefit in the worst class of cases. It is sometimes necessary to use something to lessen the number of paroxysms. In this class of cases even the administration of chloroform is justifiable in order to secure sufficient quiet for the administration and retention of food. It is a very good plan to remember that the irritability of the stomach is often the result of improper medication, hence few or no drugs should be used if the vomiting is severe, except perhaps those which are known to exert a sedative action upon the stomach.

(**Use of Drugs.**—Almost every drug in the pharmacopeia and many which are not in it have been suggested. These embrace external applications to be rubbed on the body, the use of inhalations, the use of sprays, of insufflation of powders, and the internal or hypodermic administration of various drugs.) In regard to the value of drugs to be applied *externally* on the skin I am extremely skeptical. There are one or two widely sold nostrums applied in this manner which I have seen tested, although against my advice, on a large number of cases. I have never seen the course of the disease influenced at all by their use. It should be borne in mind in this connection, as well as in other forms of medication, that whooping-cough is a self-limited disease, that a drug used in the sixth week will often give gratifying results where the same drug given in the first few weeks would be described as useless. The use of *inhalations* is an idea that has attracted many and has led to the sale of various drugs that are to be vaporized by various methods. I have never been able to satisfy myself that any of these had any value, except where there was a complicating bronchitis. In most cases they do more harm than good by interfering with the use of the proper amount of fresh air.

In case of *bronchitis*, just mentioned, inhalations of the steam from lime water or a dram of compound tincture of benzoin to a pint of water, or the same quantity of creosote to a pint of boiling water, may be used with a certain amount of benefit. The inhalations may last from five to ten minutes and be repeated at intervals of two, three, or four hours. Plenty of fresh air should be supplied in the interval. Spraying the nose and throat I do not believe to be of any value in uncomplicated whooping-cough, although where there is coryza or irritation of the mucous membranes of the throat they are of some value in lessening the excessive number of attacks which may be caused by the irritated mucous membranes. The habitat of the pertussis bacillus is apparently in the bronchi, and is not influenced by medication of the upper air passages, and this applies also to the insufflation of powders of various kinds. These measures serve to keep the family of the patient occupied and give them a sense of having done something, but, as far as the patient is concerned, unless there are specific indications, on account of complications, they serve more to excite paroxysms than to lessen them. Bravo and Soltman are very enthusiastic over the use of cyprus oil diluted with alcohol in the proportion of 1 to 5, of which two or three drams (8 to 12 gm.) are poured over the pillow at night or the underclothing during the day. My experience with this method of treatment has not been great, but in the few cases in which I have tried it it did not seem to have any effect one way or the other. The use of drugs internally, or in exceptional cases hypodermatically, properly done, has been the means of affording great relief to the patient. It is well to bear in mind that there is no one drug which will act equally well in all cases, and what will succeed admirably in one case will have little or no effect in another. It should also be remembered that the continuous use of any one drug may be dangerous on account of its depressing effect, or that it may lose its value in lessening the number of paroxysms due to the body acquiring a tolerance for it. Any drug which causes nausea or vomiting should be immediately discontinued.

The drugs which, from my own personal experience, have proved of greatest value are as follows: Atropin or belladonna and heroin I believe to be of about equal value and come first on the list. Antipyrin, either alone or combined with codein sulphate, I should place second, with the distinct disadvantage that it cannot be continued over very long periods of time without danger of antipyrin poisoning, and its use is not advisable in the case of patients with weak hearts. In older children quinin and also camphor may be prescribed to advantage. Bromoform is of great value (v. infra). It would seem that, starting with hexamethylenamin as a base, some new compound might be devised, which, if administered early in the disease in sufficient quantities, might act as a germicide and so modify the course of the disease, even to the point of cutting it short. Up to the present time a preparation has not been forthcoming, but I think the suggestion is worthy of further investigation. The method of administering the

above named drugs is important. Heroin is best given in which the form of heroin hypochlorid in the form of an elixir, and the dose may be ^{It is} ^{ary from gr. 1-100} ^{according to the age} to 1-24 (gm. 0.00065 to 0.0027). This dose may be given, ^{being that of from four to six} ^{case in children it causes} of the child and to the effect which it produces, in intervals ^{much made} hours. Occasionally the interval may be shortened. In some ^{it causes} drowsiness, but if a very small dose is first chosen and the inter- ~~val~~ this may easily be avoided. Heroin, in many instances, will cut the number of paroxysms in half and sometimes stop them almost altogether. In other cases it is of particular use in stopping the vomiting. I have repeatedly seen the vomiting cease under its use to recur when the drug was stopped. When the dose is carefully regulated so as to get the smallest amount which will produce the desired effect, it may be continued over periods covering weeks without any untoward effects. It is a good plan to stop it every week and see whether it can be dispensed with, when it may be resumed if necessary. In every case where it is employed the bowels should be carefully regulated, using mild purgative drugs if necessary. The use of atropin or belladonna is of remarkable value in a certain number of cases, and the latter may be given in the form of a tincture of belladonna in doses of from 1 to 10 minims (0.06 to 0.6 c. c.) four or five times a day. I usually prefer a solution of atropin sulphate in the strength of 1 grain to 2 ounces (0.065 to 64.00 gm.) of water. Each drop of this approximately represents 1-1000 of a grain (0.00065 gm.). My method is to start with one drop of this solution and to increase one drop each dose until flushing results. This comes on fifteen or twenty minutes after the administration of the drug, and when it is noted the dose should be diminished one drop, or, if the flushing still persists, to the dose which is just short of causing it, and this dose may be repeated at intervals of three or four hours. This may be kept up over periods lasting for several weeks, although it is well to stop the drug every week for a day or two and note the effect without it. If necessary, as in the case of heroin, it may be resumed. It should be noted that, as a rule, blonds require less than brunettes, and that it may occasionally cause delirium, mydriasis, and dryness of the throat. This is not liable to happen unless the dose has been too large, or the individual unusually susceptible. Antipyrin may be given in doses of from 1 to 5 grains (0.0625 to 0.324 gm.) and it may be used with or without codein sulphate, in the doses of gr. 1-60 to 1-4 (0.001 to 0.016 gm.) according to the age of the child. For younger children the syrup of orange is a very satisfactory vehicle, while older children may take it in capsules. Codein sulphate alone is often of considerable value. Quinin, which was suggested by Binz, has the disadvantage that in young children it is exceedingly liable to cause nausea and vomiting and is difficult of administration. In older children the disagreeable effects attending its use, consisting of tinnitus and deafness, are often complained of. The suggestion has been made to use it in doses of about gr. 1-6 (0.01 gm.) for each month of the child's age and about grs. 1 1-2 (0.1 gm.) for each year of the child's age. This should be given four times a day. Bromoform is of decided value on account of its marked sedative action, but poisoning has resulted so frequently from carelessness in its use that it is perhaps best not administered, except where persons of a reasonable degree of intelligence are entrusted with it. It may be given in doses of from 1 to 5 drops on sugar. Emulsions of it have been suggested, and may be used if thoroughly shaken before the dose is poured out, but the drug, being heavy, tends to separate and fall to the bottom of the bottle and this results in the last few spoonfuls in the bottle containing nearly all of the bromoform. There are numerous cases of poisoning on record from this cause. Cocain hydrochlorid may be of value in certain cases of extreme vomiting.

Various attempts have been made to secure an *antitoxic serum*. Kelaiditis claims to have a serum of value, and Leuriaux also has made a serum. As far as I am familiar with the literature of infectious diseases, I think it may safely be asserted at this writing that no serum worthy of consideration from any other than a theoretic interest has been produced up to this time. The subject of the use of *vaccines* in the treatment of the disease is now being studied, vaccines containing dead bacteria being injected hypodermatically at intervals of one or more days. The results so far obtained cannot be said to be very beneficial, and yet with a method like this satisfactory conclusions can only be hoped for after several years of careful experimentation. The production of a vaccine for the prevention of the disease might also be undertaken.

CHAPTER XI

INFLUENZA

WILLIAM H. SMITH

Pfeiffer's publication of his discovery of the influenza bacillus in 1893 (36) led to the hope that a definite etiology for influenza, as for typhoid and tuberculosis, had been found. The influenza bacillus is accepted, generally, to-day as the cause of epidemic influenza, but there is no such clear-cut, definite importance attached to its presence in secretions as in the case of the gonococcus, tubercle, or typhoid bacillus.

The literature from 1895 is filled with reports of the isolation of the influenza bacillus from the sputum, or at post-mortem in cases of measles, scarlet fever, diphtheria, and tuberculosis. (Leiner, 30; Wohlwill, 46; Jehle, 21; and others.) Similar, if not identical, organisms have been found in conjunctivitis and whooping cough. The writer has repeatedly isolated influenza bacilli from the sputum in cases of chronic bronchitis and bronchiectasis; and has found that these bacilli persist for years in the bronchial secretion; and that they may be present in practically pure culture at the time of an acute exacerbation.

The prevalence of the influenza bacillus, so widespread, and associated with so many diseases, especially with the acute exanthemata, has led, on the part of some, to skepticism as to the actual pathogenic power of these bacilli. In patients with disease, clinically influenza, the absence of the influenza bacillus has tended to increase this skepticism. Curschmann (10) in such an epidemic reported the presence of the pneumococcus in 46 out of 49 cases. The presence of the pneumococcus, streptococcus, streptococcus mucosus, micrococcus catarrhalis, and staphylococcus, has been reported in similar acute infections resembling influenza.

The presence of hemophilic bacilli, similar to the influenza bacillus, with slight variations, as described by Bordet (6) in whooping cough, and recently by Cohen (8) in cerebrospinal meningitis, has raised the question as to whether sub-varieties of the influenza bacillus might not exist. The pseudoinfluenza bacillus described by Pfeiffer is, according to Jochmann (22), judging from the present evidence, but a modified form of the influenza bacillus.

The uncertainty of the bacteriologist is paralleled by the indefiniteness of the clinician. Any acute cold is called influenza by some clinicians; others, dwelling on the widespread occurrence of the bacillus in other diseases, even when they find the influenza bacillus in the secretion of the suspected case, question whether these bacilli may not be saprophytes, and hesitate to call the disease influenza. A third group takes the fixed stand that where the influenza bacillus is there is influenza.

Pfeiffer's dictum that the bacilli were not found in the blood is becoming more and more questioned at the present time, because of the ever-increasing number of cases of septicemia, pyemia, endocarditis, arthritis, and meningitis reported by accurate observers with bacteriological data. Horder's (20) case of endocarditis in which the influenza bacillus was isolated from the blood four times during an interval of six weeks is a remarkable one; the influenza bacilli were isolated from the valve in pure culture at autopsy. The results obtained by Ghedini (17) in cultivating this organism from the blood are surprising, when, in 28 patients with influenza, the influenza bacillus was isolated 18 times, or 64 per cent.; and from 14 spleen punctures recovered 8 times, or 57 per cent. These observations need further confirmation. He insists that the blood culture must be taken during the fever period. The future may show that the influenza bacillus will be found to produce many acute and chronic conditions now little suspected. Blood cultures should be more generally employed by clinicians to determine if some of the fevers of unknown origin may not be due to an infection with the influenza bacillus.

Admitting the indefinite bacteriological and shifting clinical position, but accepting the influenza bacillus as the cause of epidemic influenza, let us consider its treatment.

PROPHYLAXIS

The source of infection lies chiefly in the nasal and bronchial secretions. A study of the last pandemic seemed to show that new districts became infected when visited by persons with the disease; that mild unrecognized cases might infect; that infection followed direct lines of communication. Parson's publication (35) is of interest in this particular. Of several thousand persons engaged in deep-sea fishing on Dogger Bank or Skilling Bank, North Sea, not one is known to have contracted influenza at sea; the few outbreaks occurring commenced two or three days after leaving port, or, in one case, after communication with another vessel. He also found the engineers and firemen, employed on four of the largest railroads out of London, were affected about half as often as the clerks who were indoors, and in contact with each other. Of 7,942 clerks, 722, or 10 per cent., were affected; while of 9,693 engine drivers and firemen, 522, or 5.4 per cent., had the disease. Any attempt

to isolate all cases of influenza during a pandemic is impossible; it is likewise impossible to restrict travel or enforce quarantine for a disease usually so mild, of short duration and low mortality. Absence of a direct means of treatment, which in the future may be offered by a serum therapy, makes it impossible to provide actual prophylaxis. The difficulty of any prophylactic means is increased because of the short incubation and easy communicability of the disease. The presence of bacilli, in interepidemic periods, in so many possible carriers, as shown by Holt (19), Lord (31), and others, renders it even more difficult, especially as the prevalence of these cases is not generally recognized by physicians. Certain suggestions may be made. When possible, persons with influenza should be isolated. Sputum and nasal secretions should be collected on gauze and burned. In sneezing and coughing infected persons should hold gauze or a handkerchief before the face. The clothing and dishes used by the patient should be washed separately. Elderly persons and children, when the disease is epidemic, should be kept from contact with any case, however mild. Unnecessary attendance at crowded gatherings should be discouraged. Fatigue and over-exposure should be guarded against. It is possible that hexamethylenamin (0.56 gm.), $7\frac{1}{2}$ grains three times a day, may have a prophylactic value. Quinin and oil of eucalyptol have also been recommended. Patients with chronic cough whose sputum contains influenza bacilli should take especial care to destroy their sputum. Rooms occupied recently by patients with influenza should be disinfected with formaldehyde.

TREATMENT

SPECIFIC TREATMENT

Judged from our present knowledge the disease is a toxemia, it may occasionally be a septicemia or pyemia. It is generally conceded that one attack confers but slight, if any, immunity. At present we have insufficient data in regard to any direct treatment with vaccines, antitoxin, or immune sera; although Cantani (7) and Latapie (27) obtained sera having certain protective properties. Isolated cases have been reported where vaccines were used, but the results are not uniform.

Flexner (14) has reported that a serum has been obtained from goats which had been inoculated for a long time and repeatedly with virulent cultures of the influenza bacillus. This serum had been found an efficient therapeutic agent for experimental influenzal meningitis in monkeys. This discovery leads us to hope in the future for the serum treatment of influenza, especially for those cases of meningitis due to this bacillus.

GENERAL TREATMENT

One has but to read the treatment employed during the epidemics of the 16th and 17th centuries as detailed in "The Annals of Influenza," published by the Sydenham Society, where bleeding, purging, blistering, and emetics were extensively used, to realize that the tendency of the disease is to recovery. In spite of the treatment of those times the mortality was low.

The onset of the disease is usually sudden, with chill, or chilly sensations, occasionally with delirium or coma. The temperature rises suddenly to 101 or 102, or even higher; the proportional rise of pulse is frequently much less. Coincident with the onset of the disease irritation of the nose, pharynx, larynx, or trachea may be noticed, with, at times, acute inflammation of the tonsils. The headache may be extreme, frequently frontal or orbital, or there may be, from the toxins, a meningeal irritation simulating meningitis, as in certain of the other acute infections. The soreness and lameness in the muscles of the back and thighs may be very great, the prostration marked. Within 48 to 72 hours the temperature may be normal and the patient comfortable. The transition from health to disease in influenza is frequently very rapid, as may be the recovery in patients whose condition at onset was most grave.

If seen at the beginning of the disease the patient should be put to bed, as there is no way of estimating the amount of toxin present, or the resistance of the individual patient, and experience has shown that patients thus treated suffered less from complications and slow convalescence than did those who tried to work and keep about.

When practical the patient should be isolated, the sputum and nasal secretion collected on gauze and burned. If the bowels have not moved a mild purge like sodium phosphate (2.8-3.8 gm.) 45-60 grains, or a small dose of hydrargyri chloridum mite (0.032-0.065 gm.), grain 1-2 to 1, followed by some mild saline, may be given. A warm bath may be taken, while hot drinks like lemonade, milk, or whisky may be given to favor perspiration and to dilute toxins.

For the pain and discomfort some of the antipyretics like acetphenetidin (0.65 gm.), grains 10, with caffeine (0.065 gm.), grain 1, can be ordered, repeated in an hour. Variation in the size or frequency of the dose must be determined by the patient's condition and the judgment of the physician. Aspirin (0.65 gm.), grains 10, every hour for three or four doses, may be given, or sodium salicylate or quinin. Acetanilid, because of its depressing effect, is seldom needed in this disease and should only be used where the susceptibility of the patient to this drug is known beforehand. In the absence of any direct antitoxic treatment the object is to relieve the headache, backache, hyperesthesia, and general discomfort produced by the fever and toxins, by diluting these toxins, and to

obtain comfort for the patient with the least depressing drug. If, at the beginning of the attack, there is much cough which is irritating, hard and non-productive, some sedative in addition to the antipyretic should be used, such as codein (0.015-0.030 gm.), grain 1-4 to 1-2, or heroin, diacetyl morphin (0.005 gm.), grain 1-12. Small doses of pulvis ipecacuanhæ et opii (0.5 gm.), grains 7 1-2, will be of value. At times for the severity of the pain morphia must be used.

Diet.—The patient should be fed according to his digestive capacity. If there is much renal irritation present meat and meat soups should be used sparingly. Water in abundance should be taken to dilute toxins.

Fever.—The fever in the usual, acute, uncomplicated case of influenza is of short duration and seldom needs treatment. Hyperpyrexia may occur, but even this is seldom long continued. Cold baths for reduction of fever in this disease should not be used. The patient should be kept in bed, or, at least, in his room, until the morning and evening temperatures are practically normal. Usually in uncomplicated cases, at the end of three or four days the acute toxic manifestations have subsided, the temperature has reached normal by lysis, and the patient has become comfortable. Relapse more severe than the original attack may occur, or debility and prostration with protracted convalescence may follow the mildest case. In those patients previously debilitated, or in whom the nervous system is unstable, too early a return to customary occupation should be forbidden, as in this type of patient relapse is more prone to occur and neurasthenic symptoms or delay in convalescence is more probable.

TREATMENT OF TYPES

Dependent upon the localization of toxins certain types in influenza have been described. Leichtenstern's classification (29) is as follows I. The Purely Toxic Variety—(a) The simple influenza fever. (b) The nervous form of influenza. II. The Toxic Inflammatory—(a) The catarrhal respiratory. (b) The gastrointestinal variety. Osler's classification (34) is the more usual one. I. Respiratory. II. Gastrointestinal. III. Nervous. IV. Febrile. It is impossible to maintain, in certain cases, any clear-cut separation into types, as frequently the various forms are combined or merged into each other. A study of 847 cases of influenza recorded at the Massachusetts General Hospital showed the majority to be of the respiratory type, while a large number of these patients at entrance so simulated typhoid that they were placed on enteric precautions. In certain epidemics a tendency to hemorrhage has been observed, but this type is less common.

Respiratory Type.—The discomfort in the pharynx and tonsils, which is present in some cases, is usually relieved by the simple antipyretic

¹ The diagnosis of these cases was in the main clinical rather than bacteriologica

treatment. For the engorged larynx and trachea, where it is possible, steam inhalations are of value. Compound tincture of benzoin, 3 or 4 c. c., may be added to 1 or 2 liters of hot water and the steam inhaled. The steam atomizer with an oil spray may be used. \mathcal{R} Albolene (30 c. c.) 1 ounce, Menthol, Eucalyptol $\hat{a}\hat{a}$ (0.65), grains 10. The Acme atomizer is a good one. Special attention should be paid to the possible infection of the sinuses and middle ears. The use of warm normal salt solution with a Birmingham douche, by keeping the mucosa clean, is said to lessen this danger. When infection of the sinuses occurs steam inhalations or the use of adrenalin spray (1-5,000) or a 1 or 2 per cent. solution of cocain may favor natural drainage by shrinkage of the engorged nasal mucous membrane. Morphia may be needed for the pain, or operative interference necessary. Paracentesis should be performed early if the middle ears become infected, thereby lessening the danger of mastoid involvement and sinus thrombosis. In a case of influenzal rhinitis of four years' duration Grandy reports the relief obtained by the use of influenzal vaccines in doses of 12,000,000, 500,000,000, and 10,000,000. Influenza bacilli were present with cocci in the cultures from the purulent nasal secretion.

Bronchitis.—This may be circumscribed, unilateral, or very extensive, involving the smallest bronchioles. The sputum may be abundant and at times bloody. In the acute stage a small dose of a sedative like codein (0.015 gm.), grain 1-4, or heroin (0.005 gm.), grain 1-12, may be used. With much secretion sedatives should be used with caution. Later, if the secretion is abundant and difficult to raise, ammonium chlorid (0.32 gm.), grains 5, may be taken with some hot drink every 3 or 4 hours. In the more chronic bronchitis, which often follows the attack, potassium iodid (0.32 gm.), grains 5, in milk three or four times a day is recommended. Change of climate is advisable for patients in whom the bronchitis is protracted, if the condition of the patient otherwise permits. For the paroxysmal cough occurring in influenza quinin is said to be of value.

Gastrointestinal Type.—Symptoms may arise, during an attack of influenza, from the gastrointestinal tract. These symptoms may be the only manifestation of the disease, or, as is more usual, they may appear in association with symptoms from the respiratory tract. These symptoms vary from simple dyspepsia, gastric irritation with nausea and vomiting, intestinal irritation with colic and diarrhea, to those in the rarer cases where blood may be vomited, or bloody diarrhea may occur. Reiss, in analyzing the cards in the German Collective Investigation of the epidemic of influenza in 1889 and 1890, found, of 3,231 cards submitted, catarrh of the stomach was present in 610, or 18.9 per cent.; catarrh of the stomach and intestines in 502, or 15.5 per cent.; catarrh of the intestines alone in 233, or 7.2 per cent. Loss of appetite, vomiting, and diarrhea were the more common manifestations of the effect of the toxins on the gastrointestinal tract, occurring in from 32 to 34 per cent. of the cases.

Pain was a rare manifestation, present in from 4 to 5 per cent. The percentage of cases bleeding from the stomach or intestines was 5.3 per cent. The condition of the gastrointestinal tract varies from a mild gastroenteritis to extensive engorgement of the mucosa with hemorrhage. Swelling of the Peyer's patches and mesenteric glands has been observed. Ulceration in the jejunum has been reported by Kuskow (26). The influenza bacillus was isolated from the pus of an appendix abscess by Adrian; and Fisch and Hill have reported a case of purulent peritonitis with isolation of the influenza bacillus in pure culture. During an epidemic of influenza great care should be taken not to attribute to the influenza toxins abdominal pain, really due to an acute inflammation of the appendix.

The treatment of the gastrointestinal manifestations of influenza, whether occurring alone or associated with the respiratory or nervous form, must be symptomatic. If any food is retained, milk, or milk and vichy, koumyss, albumin water, or thin gruels may be taken. If the nausea persists, rectal feeding may be necessary. Hot salt solution enemas, or seepage, if the bowel is not too irritable, may be of benefit. The dilution of toxins should be attempted by having the patient drink an abundance of water, and, if this is impossible, salt solution should be used subcutaneously. The excretion of this fluid should be favored through the skin and kidneys. Brandy and shaved ice, or champagne, in small amounts taken frequently may relieve the vomiting. Bismuth subnitrate (1.9-2.9 gm.), grains 30-45, may be given every 6 or 8 hours. Some of these cases are relieved by acetphenetidin, or other simple antipyretics. The symptoms are, fortunately, usually of short duration, but vomiting may persist and much loss of flesh occur. This type of the disease was rare in the cases at the Massachusetts General Hospital. Cholecystitis, due to the influenza bacillus, has been reported by Laubheimer (28), Heyrovský (18), and Kuina (24), four cases in all, where the bacillus has been isolated. Karewski (23) and Ruheman (37) each report a case of liver abscess in influenza, but the bacteriology is indefinite. Neutralization of toxins by dilution, favoring elimination through the skin and kidneys, symptomatic treatment of the nausea with careful feeding with the use of bismuth or some allied drug represent, at present, our means of treatment. Counterirritation has been advised; in certain cases opium or morphia must be used for the pain or frequent bowel movements.

Nervous Type.—In addition to the headache, delirium, the occasional case beginning with coma, the restlessness and insomnia, all manifestations of the toxin on the nervous system, cases have been reported of hemiplegia, myelitis, encephalitis, paralysis resembling Landry's, where organic change has occurred. The literature is very extensive of the cases with neuralgia and multiple neuritis, together with the cases of exhaustion

psychoses and occasional mania. From Leichtenstern's (29) collection of cases it is seen that scarcely any portion of the nervous system has escaped injury from the influenza bacillus or its toxin. The tendency of the usual mild manifestations due to toxemia is to subside under the ordinary treatment with antipyretics, warm baths, and the usual measures suggested to dilute toxins; abundant fluid intake, favoring perspiration, salt solution by rectum or under the skin. Drugs or drug treatment must be applied for the relief of symptoms. When organic lesions, such as encephalitis or myelitis, are present, there can be no specific treatment in the light of our present knowledge. It is to be hoped that in the future some specific treatment like an immune serum will be found which not only will neutralize the toxins produced by this bacillus, but will prevent the extensive organic changes so frequently reported as having occurred in the nervous system, due to the destructive process of the influenza bacillus or its toxins. The persistent neuralgias, exhaustion psychoses, acute manias, tend to recover and do not differ from similar conditions seen less frequently after other acute infections like typhoid or pneumonia. The underlying debility must be recognized and tonic baths, with other hydrotherapeutic measures, employed. Massage, forced feeding, in certain cases a modified rest cure, must be insisted on. Quinin in large doses is said to act well for the persistent neuralgias. If facial neuralgia persists the possibility of antrum disease must be considered. Liquor potassii arsenitis (0.24 c. c.) minims iv, well diluted after meals, increasing the dose gradually, is recommended, as is also strychnia in some form for the debility and general weakened condition. Drugs for sleeplessness, which is often persistent, must be used, but should be used only in connection with other measures, the aim of which is to build up the general condition of the patient. When pain is absent sulphonethylmethane (1 gm.) 15 grains, or chloralamid may be of value. Certain of the American neurologists think the importance of the influenza toxins on the nervous system has been overestimated. The underlying neurotic disposition, in many of the patients suffering after an attack of influenza from nervous manifestations, is recognized by several writers.

COMPLICATIONS

Pneumonia.—This is one of the most dangerous complications of influenza. Its frequency varies in different epidemics and in various localities. It is usually a broncho- or lobular pneumonia. Mixed infections with the streptococcus and pneumococcus are common. Lobar pneumonia, when a complication, is probably due to the pneumococcus. The recognition of the bronchopneumonia in influenza is frequently difficult, at times impossible. Exacerbation of symptoms, with rise of temperature, pulse, or respiration, should suggest it. The areas of consolidation are frequently

so small that dulness is lacking and bronchial expiration absent. Attention has been called to the frequency with which these foci may be multiple.

In eleven fatal cases studied by the writer where influenza bacilli were present in the exudate, in culture, and in sections of the pneumonic foci, in one case four lobes showed foci of consolidation, three lobes three times, two lobes once, and one lobe six times. The right upper lobe was involved in five cases.

The possibility of confusing such cases with tuberculosis must be mentioned. The diagnosis in interepidemic periods may be made by the sputum examination; the sputum may be mucopurulent, purulent, or at times blood tinged, and will frequently show the presence of the influenza bacilli in large numbers alone or in association with the streptococcus or pneumococcus.

When extension into the lung occurs, supporting measures must be pushed, nutrition kept at a maximum. Alcohol in some form should be given freely. Whiskey (30-60 c. c.), one or two ounces every four or six hours, or oftener, watching its effect, or champagne may be used, if preferred. Expectoration should be favored by the use of ammonium chlorid or aromatic spirits of ammonia if there is associated extensive bronchitis. If the heart shows signs of weakness strychnia should be used at once and freely (0.0016 gm.), grain 1-40, subcutaneously every three or four hours, or oftener, for short periods, or caffein may be given in appropriate dosage. Intravenous or subcutaneous injections of sterile salt solution may be employed. In elderly persons small doses of the tincture of digitalis (0.30 c. c.), minims v, given every 6 or 8 hours from the onset of the pneumonia may prove of value. As the disease is frequently of long duration, attention must be paid to obtaining sufficient sleep for the patient. When secretion is not excessive or when easily raised morphia may be used. Trional (0.65 gm.), grains 10, may be all that is needed. Where the heart's action is good and kidney secretion free, liquids should be given freely. The disease terminates usually by lysis. Recrudescence may occur and typhoid or tuberculosis be simulated. The signs of consolidation may persist in exceptional cases for weeks. If pleuritic pain is present it may be controlled by a tight swathe, by hot or cold applications, or, in certain cases, morphia will be needed. The possibility of pneumothorax from the subpleural perforation of a bronchopneumonia patch, localized abscess, gangrene, or empyema, as reported by Mosler, Fürbinger (16), Kundrath, Pfeiffer, and Rhyner, must be remembered in this type of pneumonia. Bronchiectasis may be a sequel. The mortality of influenza pneumonia is variously stated at from 17 per cent. (the German Collective Report) to 43 per cent. (by Kranhalls, 25). Ghedini (17) has recently called attention to the pleural effusions after this disease. Davis (11) reports in one case of influenza pneumonia treated with influenzal vac

cine, 500,000,000, that there were chill, rise of temperature, and local reaction.

In one patient with chronic bronchiectasis, exacerbation, and influenzal pneumonia, observed by the writer, injections of vaccine were followed by hemoptysis.

Cardiocirculatory Complications.—The acute cardiac failure following influenza leaves little opportunity for direct treatment. The subcutaneous injection of camphor, ether, alcohol must be tried. The heart suffers in two directions from the action of the influenza bacillus: the effect of the toxins producing irritability and myocardial insufficiency and the more rare effect on the endocardium and pericardium. For the irregularity dependent upon nervous change, rest, at first with strychnia (0.0016 gm.), grain 1-40, every 6 or 8 hours may be valuable. The patient must be considered as well as his heart, and careful feeding and general tonic treatment carried out. If there is myocardial weakness with dilatation and limitation of the field of cardiac response, tincture of digitalis should be used. Spiritus etheris compositus, atropin, strophanthus have each been recommended. Krehl, in speaking of the diseases of the heart occurring after influenza, is inclined to think that in most cases the cardiac disturbances are chiefly to be explained by an increase in the already existing cardiac affection, and by the influence of the general damage to the nervous system and the general health. The pathology of cardiac change in influenza is less well understood than is this change after most of the acute infections. The recent accurate observations on influenzal endocarditis, with the reported cases of Spät (42), Saathoff (38), Horder (20), and Smith (41), should attract attention to the possibility of the influenza bacillus being more frequently a cause of endocarditis than has been considered in the past. At present the treatment must be symptomatic. Horder suggests, in another case, he would inoculate the patient with a dead culture of the organism, hoping that by a process of vaccination the increased resistance of the patient might combat the infection. The case of septicemia, secondary to bronchopneumonia, reported by Madison (33), where influenza bacilli were isolated from the blood, recovered after an illness of sixty-eight days. Thursfield (44) has recently reported two cases of septicemia, one secondary to an attack of influenza, the second following a phlebitis. In both patients the influenza bacilli were isolated from the blood. Recovery occurred in both cases.

Meningitis.—One of the rarer manifestations, formerly of bacteriological and pathological interest, has, during the past few years, become of interest clinically. It is now known from bacteriological proof that meningitis due to influenza bacilli is sufficiently widespread to suggest that in the past cases have been overlooked. The attention of the clinician was called to this by Cohoe (9) and Adams (1). Cohoe, in 1909, collected

26 cases from the literature where the bacteriological data were fairly trustworthy. In the article by Davis (12) 40 cases were collected; 5 cases being observed in Chicago in a little over a year. Since this paper other cases have been reported in America, France, and England. Recently Wollstein (47) has stated that 8 cases have come under her personal observation. Cohoe states the mortality of his 26 collected cases as 85 per cent. Flexner (14) records that all but 6 of the 58 cases up to the present reported have died. The increasing number of these cases calls the attention of the clinician to the necessity of their recognition.

Treatment.—Batten (3) records one case where urotropin was used with recovery of the acute condition. In two other cases treated by influenza vaccine, 25,000,000 and 12,500,000 in one case and 2,500,000 in the other, both died. Lumbar puncture should be employed for diagnosis. Relief of symptoms has followed its use in influenzal meningitis. It is hoped that with early diagnosis, and an immune serum as suggested by Flexner (14) for his experimental influenzal meningitis in monkeys, direct treatment will result.

Rarer Complications.—The treatment of the occasional thrombosis or phlebitis occurring in this affection must be symptomatic. Nephritis, toxic in type, secondary to influenza, is a rare complication, seldom occurring in infants. The tendency is to recovery. During the acute stage the patient should be confined to bed; kept between blankets so that a more uniform temperature may be obtained. His diet should be bland. A mild diuretic like *mistura ferri et ammonii acetatis* (3.7 c. c.), 1 drachm, every 6 or 8 hours, may be all that is needed. Occasionally the nephritis becomes chronic. Fatal cases have been reported. Affection of the joints with pus formation due to the influenza bacillus has been reported by Dudgeon and Adams (13), Weil (45), Slawyk (39), and Fraser (15). While usually part of a pyemia, in Fraser's case, where the knee was involved, incision was followed by recovery.

Chronic Influenza, Bronchiectasis.—Pfeiffer first called attention to the persistence of the influenza bacillus in the sputum after the acute attack. Leichtenstern (29) reports two cases, simulating tuberculosis, followed for two years, with post mortem examination excluding tuberculosis. Lord (31) reported, in 1902, eighteen cases of chronic infection with the influenza bacillus.

In two cases followed by the writer for two years influenza bacilli were constantly cultivated from the sputum. Post mortem examinations in both showed diffuse bronchiectasis and pneumonitis.

The cases usually have chronic cough, worse in winter, with abundant purulent or mucopurulent sputum. They are subject to acute exacerbations or even bronchopneumonia; one patient has had three such attacks

in five years. Hemoptysis may occur, and the question of phthisis is often raised; indeed, in some cases this mistake has been made. They are subject to asthmatic attacks, and, unless the underlying bronchiectatic condition is recognized, sedatives will do harm, when expectorants or mild emetics, by favoring emptying of the cavities, will benefit. This condition is found in youth and in early adult life as well as in middle age. Repeated sputum examinations may be necessary for diagnosis, for frequently a shower of influenza bacilli will appear suddenly, and isolation in pure culture is simplified. Several of these patients have had their sputum examined repeatedly for tubercle bacilli with negative results. They have not reacted to tuberculin.

It is very important that these cases should be recognized and during acute exacerbations of the disease, or bronchopneumonia attacks, blood cultures should be made to see if the influenza bacilli may not be isolated.

Treatment.—A twenty-four-hour estimate of the amount of secretion should be made, as it gives an index of the degree of damage present. Patients should be taught to drain their cavities; oftentimes if hot drinks are sipped before rising, while dressing, or before meals, attacks of coughing are prevented and frequently the sputum is raised more easily and the exhaustion resulting from the exertion of coughing is minimized. This is important especially in elderly people in whom the tendency to emphysema is marked or cardiac insufficiency probable. A mild saline cathartic should be taken to keep the intestinal tract clean, for it is impossible to prevent swallowing some of the secretion, which is oftentimes excessive. One patient was relieved of a chronic diarrhea by the simple procedures mentioned above. Expectorants, as potassium iodid or ammonium chlorid, should be used to favor secretion; codein and heroin withdrawn. If stasis in these cavities occurs and the sputum or breath becomes foul, oil of eucalyptus (0.12-0.18 c. c.), minims 2 or 3, on sugar two or three times a day may be found of value. The hemoptysis requires no treatment. The asthmatic attacks are relieved by expectorants. For the acute exacerbations with fever, malaise, headache, and, not infrequently, bronchopneumonia the treatment as outlined for those conditions should be used. As many of these patients are practically free from cough in the summer months, in the winter they may find comfort in a warm climate—the tendency is, however, to recurrence wherever they are. Boggs (5), and Madison (32), and Beck (4) have called attention to these chronic bronchitis cases with bronchiectasis, with influenza bacilli in their sputum.

Surgery at present offers little relief for the condition. The difficulty of localization is extreme, the cavities are frequently bilateral and multiple. The X-ray plates are frequently unsatisfactory because of the associated thickened pleura.

CONVALESCENCE

In no disease may an apparently so mild attack be followed by such debility, prostration, and frequent insomnia. In most of the cases, after the acute attack is over, restoration to health is rapid and complete. Where debility and prostration persist, long absence from work must be urged; the appetite catered to, forced feeding insisted upon. Massage, arsenic, iron, or quinin, hydrotherapy, all in certain cases will be needed. Each individual case must be studied and appropriately treated for the underlying condition of debility, asthenia. Where the cough persists, selected cases will benefit by climatic change. This should not be urged, however, unless equally good food and home comforts can be obtained. Patients with organic change in heart, lungs, or kidneys should be particularly guarded in convalescence from influenza.

SUMMARY

Epidemic influenza is due to the influenza bacillus. The frequent presence of this bacillus in acute infections other than influenza suggests a saprophytic existence. Possibly the bacilli of Bordet and Cohen may be strains of the influenza bacillus. Frequent so-called epidemics of influenza are due to other organisms. Influenza bacillus is more frequently present in the blood than Pfeiffer thought. Importance of recognizing influenzal septicemia, meningitis, and endocarditis.

Prophylaxis.—Secretions from nose and throat dangerous. Face should be protected by gauze in coughing and sneezing. Sputum burned. Possibly quinin or hexamethylenamin may have a prophylactic value.

Specific Treatment.—No antitoxin; vaccines of limited use. Flexner's goat serum may prove of value, especially for the meningitis cases.

General Treatment.—Isolation where possible. Care of secretions. Antipyretics. Acetphenetidin, caffein, quinin, sodium salicylate, aspirin, acetanilid, codein, dicetyl morphin, pulvis ipecacuanhæ et opii.

Diet.—According to the digestive capacity. Fluids to dilute toxins.

Fever.—Usually short duration, no specific treatment. Avoid cold baths.

Respiratory.—Inhalations, steam, or oil sprays. Antipyretics. Codein or dicetyl morphia for cough. Adrenalin spray for sinus infection or cocain solution. Early paracentesis for middle ear involvement. Ammonium chlorid, potassium iodid for subacute bronchitis, quinin for spasmodic cough.

Gastrointestinal.—Liquids, soft solid diet. Favor elimination through skin and kidneys. Salt solution enemata. Brandy, shaved ice, champagne. Antipyretics, bismuth subnitrate or allied drug. Opium.

Nervous.—Warm baths, salt solution. Antipyretics. Later massage, tonic baths. Hydrotherapy, liquor potassii arsenitis, strychnia, sulphonethylmethane, chloralamid.

Complications.—*Pneumonia.*—Maximum nutrition, alcohol, strychnia, caffein, digitalis, sterile salt solution. Favor elimination and expectoration. Morphia, sulphonethylmethane. Frequent slow convalescence. Lysis.

Cardiocirculatory.—Camphor, ether, caffein, alcohol, strychnia, digitalis, belladonna, strophanthus, spiritus etheris compositus.

Meningitis.—Possibly hexamethylenamin. Lumbar puncture. Possibly Flexner's influenza serum. Symptomatic.

Septicemia; Pyemia.—Symptomatic. Alcohol, possible influenza vaccines.

Rarer Complications.—Phlebitis; thrombosis. Symptomatic. Nephritis. Bed, bland diet, mild diuretics.

Arthritis.—Incision, if pus present.

Chronic Influenza; Bronchiectasis.—Favor expectoration, warm drinks, ammonium chlorid, potassium iodid, saline cathartics. Avoid sedatives where there is much secretion. Oil of eucalyptus. Climate. Surgery offers but little. Diagnosis difficult, cavities frequently multiple.

Convalescence.—Treat patient. Tonics; rest; absence from work; massage. Iron, arsenic, quinin, hydrotherapy, climatic change.

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CHAPTER XII

CEREBROSPINAL MENINGITIS

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Cerebrospinal meningitis is an infectious disease of the pia mater and arachnoid membranes of the brain and spinal cord. The term refers to the anatomic lesion found in various infections of these tissues, and does not represent a single disease entity. Various etiologic factors may produce the same or different anatomic lesions, and the same or different symptoms.

In the case of cerebrospinal meningitis, the inflammatory process in the membranes covering the delicate nervous structure of the brain and spinal cord necessarily gives rise to symptoms of a severe and dangerous character, and the disease, involving as it does some of the most vital structures, is of an exceedingly fatal character. Symptomatic treatment can hardly be expected to accomplish much in a disease of this nature. It cannot modify to any great extent the morbid changes in the tissues, and, beyond the relief of certain definite symptoms, can have little hope of accomplishment.

The specific treatment of infectious diseases is still in its infancy. One of its chief accomplishments has been in cerebrospinal meningitis.

Etiology.—A variety of pathogenic microorganisms have been found as etiologic factors in the lesions of cerebrospinal meningitis. The commoner causes are the *Bacillus tuberculosis*, the *Diplococcus intracellularis*, the *Pneumococcus*, the *Streptococcus pyogenes*, the *Bacillus influenzae* (Pfeiffer), and the *Staphylococcus pyogenes*. The others are so exceedingly rare as to be isolated curiosities in pathology rather than diseases with which the practitioner must expect to cope.

There is at present *definite proof* of the efficiency of specific therapy in cerebrospinal meningitis caused by the *Diplococcus intracellularis*, and *evidence* of possible value in the forms caused by the *bacillus of influenza*, and by the *Staphylococcus pyogenes*. There is no evidence of any value from specific therapy in any of the other forms.

The relative frequency with which the various microorganisms cause

cerebrospinal meningitis probably varies widely, not only in various localities, but also because of the tendency of infections with the *Diplococcus intracellularis* to occur in epidemics.

Diagnosis of Meningitis.—In order to treat cerebrospinal meningitis it is of the highest importance to recognize with accuracy, not only the presence of meningitis, but also the particular etiologic form which may be present. There are certain symptoms and signs, frequently present in all forms of meningitis, which strongly suggest the presence of the disease. Such so-called meningeal symptoms are severe headache, rigidity or tenderness of the neck with retraction of the head, a clouding of the consciousness, varying from slight apathy to delirium or coma, vomiting, and various nervous symptoms such as convulsions, spasm of the extremities, paralysis, and abnormalities of reflexes. There is, however, no one of these symptoms which may not be absent in any case of meningitis, and which may not be present in some other diseased condition.

Not only is it impossible, on a basis of clinical manifestations, to recognize the existence of cerebrospinal meningitis with any certainty, but it is also impossible, on this basis, to distinguish with any degree of accuracy the various forms of meningitis one from another. No symptoms or signs are found in any form which may not be absent, or be found, in any other form.

The positive recognition of the existence of cerebrospinal meningitis, and of the etiologic form of the disease, can only be based on the results of *lumbar puncture* and the *laboratory examination of the cerebrospinal fluid*.

The important diagnostic characteristics of the cerebrospinal fluid are shown in the table on the following page.

SERUM TREATMENT IN CEREBROSPINAL MENINGITIS

Specific therapy has been most successful in epidemic cerebrospinal meningitis, the form caused by the *Diplococcus intracellularis*. It is carried out by means of an immune serum, derived from horses which have been immunized through successive injections of cultures of the organism. The serum, when properly administered, has produced a marked lowering in the mortality of the disease. It produces, in favorable cases, a relief of the dangerous and painful symptoms, a fall of temperature, a more rapid recovery, and prevents serious and permanent complications. For the details of its effects and a description of the theory of its action the reader is referred to the various publications on this subject.

Three points are of the first importance from the point of view of treatment. In the first place, the antimeningitis serum is a specific immune serum, and is *only of value in that form of cerebrospinal meningitis which is caused by the Diplococcus intracellularis, and is of no value*

CHARACTERISTICS OF THE CEREBROSPINAL FLUID IN MENINGITIS

	<i>Appearance</i>	<i>Pressure</i>	<i>Fibrin</i>	<i>Cell Count</i>	<i>Predominating Cell</i>	<i>Bacteria</i>	<i>Morphology</i>	<i>Staining Reaction</i>
Normal Fluid.....	Clear	Normal	Absent	Normal, 1 to 10 per cu. mm.	Mononuclear	None	.....	.....
Meningitis— Tuberculous.....	Clear or Turbid	Increased	Usually present	Increased, 10 to 900 per cu. mm.	Mononuclear	Tubercle Bacillus	Bacillus	Acid-fast
Epidemic.....	Turbid *	Increased	Present *	High *	Polynuclear *	Diplococcus Intra-cellularis *	Biscuit - shaped diplococcus	Gram negative
Pneumococcus...	Turbid	Increased	Present	High	Polynuclear	Pneumococcus	Lance-shaped diplococcus sometimes in short chains	Gram positive
Streptococcus...	Turbid	Increased	Present	High	Polynuclear	Streptococcus	Coccus in long chains	Gram positive
Influenza.....	Turbid	Increased	Present	High	Polynuclear	Influenza Bacillus	Small Bacillus	Gram negative
Staphylococcus...	Turbid	Increased	Present	High	Polynuclear	Staphylococcus	Coccus in Clumps	Gram negative

* In late cases of epidemic meningitis, especially those which have entered the chronic stage, the fluid may be clear, fibrin may be absent, the cell count may be only moderately increased, the mononuclear lymphocytes may predominate, and the diplococcus intracellularis may be absent, or very hard to find.

in any of the other forms. In the second place, the success of serum therapy in this disease is largely due to the fact that the site of the disease, bathed in the cerebrospinal fluid, allows the serum to be given in a more concentrated form than if it were injected into the blood. Concentration is an essential factor in the working of the serum, and, hence, *antimeningitis serum is of absolutely no value when given by subcutaneous injections, but must be injected into the spinal canal.* In the third place, it must be remembered that *the earlier in the course of the disease the serum is administered the better are the prospects of success.*

Indications for Lumbar Puncture.—*Lumbar puncture should be performed immediately in every case in which epidemic meningitis cannot be excluded.* If, as a result of the clinical examination of the case, some definite disease is found, which is adequate to produce the meningeal symptoms, it is usually safe to attribute them to this cause, and lumbar puncture is not indicated. When, however, no positive evidence of such a disease is found, it is better not to wait for the possible appearance of such evidence, but to do lumbar puncture at once in order to confirm or exclude the possibility of epidemic meningitis.

Technique of Lumbar Puncture.—In lumbar puncture, especially when there is a possibility that serum is to be administered, it is better not to use an anesthetic. In adult patients in full possession of their faculties, the skin may be cocainized. In children, cocainization frightens and disturbs them fully as much as the puncture, and is consequently superfluous. The patient should be lying on his side, on a firm surface, with the region of the lumbar spine brought so near the edge of the bed or table that it projects a little. Several hollow needles, two test tubes with corks, and a syringe are boiled. Hollow needles are better than trocars. Several sizes should be boiled. The smallest sizes, used for babies, are like ordinary antitoxin needles. The largest size is similar to that used in thoracentesis. The hands of the operator, and the lumbar and sacral regions of the patient, extending, on the upper side, to the highest point of the crest of the ilium, are thoroughly scrubbed with soap and water, and alcohol. An attendant places one hand on the back of the patient's neck and the other in the bend of the knees, and flexes the spine as much as possible without the use of unnecessary force. In order to avoid the risk of touching the spinal cord, the operator takes as his landmark for the upper limit of safety a transverse line at the level of the highest point of the crest of the ilium. I usually select the second interspinal space below this point for the puncture, which leaves an opportunity to try the space above and the space below, in case of difficulty in obtaining fluid. The spaces are located with the finger of the left hand. The puncture may be made in the median line between the spines, or a little to one side of the median line, between the laminæ. In either case the direction of the needle is horizontally forward. If bone is encoun-

tered the needle should be given a slight inclination upward, i. e., toward the head of the patient. The needle should be entered boldly, without preliminary pricking of the skin, but not so forcefully as to risk its breaking if bone is encountered. It should be pushed steadily in the proper direction until there comes a sudden sense of diminished resistance, which marks the entering of the spinal canal. The approximate distance in adults is about $2\frac{1}{2}$ inches. In small persons it may be less, and in very fat persons greater. The fluid should then begin to drop or spurt from the end of the needle, and is caught in the sterile test tube. The fluid is sometimes bloodstained, later running clear, or *vice versa*. As bloodstained fluid interferes with the diagnosis, the second test tube should be substituted whenever the fluid changes in character.

When lumbar puncture is properly performed, there should be no difficulty in obtaining fluid. There are, however, certain sources of difficulty which may produce a "dry tap." In the first place the needle may not enter the canal, encountering bone in its course. This means either that the direction of the needle is not right, or that the space between the bones is too small to admit the passage of the needle. In the former case the puncture must be repeated, trying various slight alterations in the direction of the needle, particularly a very slight upward slant. In the latter case the flexion of the spine must be increased, if possible, and, if this fails, a smaller needle must be tried. In babies, a very small needle is required. Sometimes an anesthetic is required to obtain the necessary flexion. Sometimes the interspinal spaces are closed by the wincing of the patient. This may be partially prevented by the attendant placing his knee against the patient's abdomen.

The needle may enter the spinal canal, but no fluid run out. In this case the first thing to be thought of is that the lumen of the needle may have become obstructed in its passage through the tissues. The stylet of the needle should be passed in, and this simple procedure is frequently followed by the appearance of the fluid. The needle may have been pushed too far forward, so that it has entered the tissues on the anterior wall of the canal, or not quite enough forward to enter the canal. This may be corrected by a slight movement of the needle forward and back. Pushing the needle too far forward should always be avoided if possible, as, even when it does not enter the tissues, it is very apt to wound a blood vessel, thus producing bloodstained fluid. The direction of the needle may be so bad as to miss the canal entirely. This must be remedied by repeating the puncture with corrected direction. If all these measures fail, it is probable that one of two conditions is present. Either the fluid is too thick, containing fibrinous masses, so that it cannot run through the needle, or else some anatomical condition is present interfering with the free circulation of the intraspinal fluid. In either of these conditions it will be impossible to obtain fluid. Before giving over the attempt, how-

ever, the operator should carefully and thoroughly repeat the puncture, both in the interspinal space above and in the one below that first chosen.

Diagnostic Inferences from Lumbar Puncture.—The diagnosis is made on the basis shown in the table of the characteristics of the cerebrospinal fluid. The order in which these inferences are made is as follows: The physician observes whether the fluid is turbid, clear, or bloodstained, and whether or not it is under excessive pressure. If the fluid is turbid, some form of meningitis is present, and, from the order of frequency of the various forms characterized by turbid fluid, the balance of probability is largely in favor of the epidemic form. If the fluid is clear, either tuberculous meningitis, or else no form of meningitis is present. If the clear fluid is under excessive pressure, the evidence is in favor of tuberculous meningitis. If the fluid is bloodstained, no immediate inference can be drawn. The confirmation and final diagnosis are based upon the subsequent examination of the fluid, carried out by ordinary laboratory methods. Cultures may be made, but it is better to rely more on the results of the examination of fresh cover-glass preparations, as the *Diplococcus intracellularis* is somewhat uncertain in its growth upon culture media.

Indications for the Administration of Serum.—The immediate injection of antimeningitis serum is indicated in every case in which, as a result of the first inferences from the lumbar puncture, the existence of epidemic meningitis is probable. *If the fluid is turbid, the serum should be given immediately, at the time of the first puncture*, provided that the physician has it with him, as he should have in any case in which meningitis is suspected. If the fluid is clear it should not be given immediately, and should be given later only in those rare cases in which the *Diplococcus intracellularis* is found in clear fluid. If the fluid is bloodstained, the serum should be given immediately in every case in which the symptoms are strongly suggestive of epidemic meningitis, or if the patient's general condition is serious. When the patient is not seriously ill, and the clinical diagnosis is doubtful, the giving of serum should be postponed until after the laboratory examination of the fluid has shown the presence of the *Diplococcus intracellularis*. If no fluid is obtained, even though the needle has appeared to enter the canal, the serum should be given only if the patient is seriously ill, or if the clinical picture is strongly in favor of the existence of epidemic meningitis. In this case it should be given with caution as to the amount injected, on account of the risk of raising intradural pressure.

The amount of fluid withdrawn depends upon the diagnostic inferences, and the indications for the use of serum. *If serum is to be given, as much fluid as possible should be withdrawn*. When the fluid shows no further evidences of pressure, and if the amount of fluid withdrawn is at least 40 c. c., it is sufficient. If this amount has not been obtained, the fluid should be allowed to run until it is dropping no faster than four

drops to the minute. If the fluid is clear, but under pressure, it should be allowed to escape as long as it runs freely. If the fluid is clear, and not under pressure, not more than a few c. c., enough for laboratory examination, should be taken.

Technique for the Administration of Serum.—The serum is injected through the same needle by which the cerebrospinal fluid has escaped, which is left *in situ*. A syringe is used, which can be boiled, and which should be sufficiently large to hold the full amount of serum to be given. The syringe must have a watertight connection with the needle, either by a rubber connecting tube with metal terminals threaded to fit the needle on the one end and the nozzle of the syringe on the other, or by means of a ground glass nozzle fitting by friction into the lumen of the needle.

I like the rubber connecting tube, because it allows for possible movements of the patient. It may theoretically be more difficult to sterilize, but I have seen no cases of secondary infection from its use.

The syringe is filled with the required dose of serum, which has previously been warmed to about blood temperature, the air is expelled, and the connection with the needle is made. The serum is injected slowly, the injection occupying approximately the same time as the fluid has taken in escaping. During the injection the patient should be carefully watched for pressure symptoms, especially if the amount of serum desired is larger than the amount of fluid withdrawn. In this case, if the operator, during the injection, should encounter a sense of increased resistance, the amount of which can only be judged by experience, he should not attempt to give the full amount. This is comparatively rare. Serious pressure symptoms are still rarer, though they may occur. As I have seen them these signs have occurred in the following order: sudden increase in headache (usually absent), irregular or stertorous respiration, cyanosis, cold sweat, and failing pulse. When they occur, the serum should be allowed to run out again through the needle until they have been relieved. After the injection of the serum has been completed, it is best to leave the needle and syringe in place for a few minutes, so that, if pressure symptoms develop, the serum may be allowed to run out at once, without the necessity of repeating the lumbar puncture. The needle is then removed, and the site of the puncture is covered with a small dressing of sterile cotton and collodion.

Amount of the Dose.—When the serum was first used, the fear of dangerous raising of the intradural pressure led to the use of doses no larger than the amount of cerebrospinal fluid withdrawn. It gradually appeared that those cases in which larger doses could be employed did better than those in which the amount of serum adjudged safe was small. This led to the use of larger doses, and, while the risk of a dangerous increase in the intradural pressure undoubtedly exists, it is certainly

much less than was at first supposed. *The minimum dose in the majority of cases should be 30 c. c.* If the amount of fluid withdrawn is less than 30 c. c., this amount should be given as the routine dose. If the amount of fluid withdrawn is more than 30 c. c., the amount of serum given should equal the amount of fluid withdrawn. In very severe or fulminating cases, especially in adults, where the amount of fluid withdrawn is between 30 c. c. and 45 c. c., it is best to give 45 c. c. of the serum.

The exceptions to this dosage are the following: In very young babies the minimum dose should be 15 c. c. instead of 30 c. c., and more than this amount should only be given when more than 15 c. c. of fluid are obtained. When very little or no fluid is obtained, it is best to give only 15 c. c., at the first injection at least. If at any time the injection of the serum becomes attended with a sense of abnormal resistance, the injection should be stopped.

Repetition of the Injection.—After the first injection has been given, the physician must decide how often, and at what intervals, the injections are to be repeated. *It must be remembered that the injection of anti-meningitis serum is only to be repeated when the laboratory examination of the cerebrospinal fluid shows the characteristics of epidemic meningitis.*

It is best, in repeating the injections of serum, not to be guided by the apparent effect of the serum, but to *repeat the dose of serum irrespective of the clinical features of the case.* In the majority of cases the interval between the injections of serum should be approximately twenty-four hours. In very severe fulminating cases the interval should be twelve hours. The most reliable guide as to how long the daily injections should be continued is to be found in the results of the laboratory examinations of the successive cerebrospinal fluids obtained at each injection. Every specimen of cerebrospinal fluid, withdrawn for the purpose of administering serum, should be subjected to careful microscopic examination, and the presence and number of organisms, together with the relative prevalence of the organisms, within or without the leukocytes, should be particularly noted. The effect of the serum on the fluid is shown by diminution of the number of diplococci, and an increasing predominance of intracellular organisms. Finally, extracellular diplococci disappear, and later no organisms can be found. The fluid becomes progressively clearer, but this change is apt to occur later than the changes in the diplococci.

The daily injections of serum should be continued as long as diplococci can be found in the cerebrospinal fluid. This rule should allow of no exception, and applies to the majority of prolonged cases. At times, however, after the use of the serum the *Diplococcus intracellularis* disappears from the spinal fluid with great rapidity, even failing to appear after only one or two injections of serum. In such a case the injections should be repeated *for four daily doses.* The number four is somewhat arbitrary, but experience has shown it to be a desirable one. If, after

four doses, microorganisms are no longer to be found in cover-glass preparations, the injections may be omitted.

The necessity of further repetitions of the injections of serum, in cases in which the diplococci have disappeared, depends on the clinical aspects of the case. When in these cases certain symptoms persist, further injections will have to be made. The persistence of such symptoms as rigidity or tenderness of the neck, retraction of the head, Kernig's sign, or abnormalities of reflexes, is not serious, and does not demand further injections. These symptoms, even in favorable cases, are likely to persist for a variable time. The persistence of such symptoms as fever, headache, hyperesthesia, and any affection of the consciousness, such as apathy or delirium, is much more serious. After the disappearance of the diplococci, four full doses at least having been given, the physician may wait three or four days, unless the persisting symptoms show, within that time, an evident tendency to get worse. At the end of three or four days, if the patient is making slow but steady progress toward recovery, he may still wait. If, however, after three or four days the patient's symptoms are persistent and his condition stationary, or if at any time his symptoms are becoming worse, the injections of serum should be resumed. If, on resuming the injections, the *Diplococcus intracellularis* is again found in the cerebrospinal fluid, treatment should be continued as if this were the first injection, the physician again being guided by the disappearance of the diplococci and the persistence of serious symptoms. The finding of the diplococcus should always be an indication for at least four injections. If the diplococcus has not reappeared, four daily injections should be given, followed by a wait of three or four days, and treatment should continue on this line until either the symptoms have disappeared, or the patient has entered the chronic stage of the disease.

These prolonged cases are more often seen when the first injection has been given comparatively late in the course of the disease. A relapse is distinguished from a prolonged case in the fact that the symptoms have not persisted, but the patient has been free of all serious symptoms, with normal temperature, and no diplococci in the cerebrospinal fluid, or has been progressing steadily toward recovery. When the relapse is marked only by a rise of temperature, it is not so serious as when such symptoms as clouding of the mentality, headache, hyperesthesia, and so forth reappear. The latter condition, especially with impairment of the mentality, may be a precursor of the unfavorable chronic stage. A relapse should be the signal for immediate lumbar puncture and injection of serum, and the treatment should be carried out exactly as if it were the original attack. Relapses will be infrequent if the treatment is properly carried out, with successive daily injections, but will occur if the patient is treated with isolated doses at longer intervals.

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by the rule laid down for the initial dose. It happens at times after the first puncture has obtained fluid, and the examination of the fluid has given the positive proof of the diagnosis of epidemic meningitis, that in subsequent efforts to administer serum the lumbar puncture fails to obtain cerebrospinal fluid. In such a case, the physician, if sure that his needle enters the canal, should be bolder in his administration of serum than if it were the first puncture, with the diagnosis unconfirmed. He should watch carefully for a sense of abnormal resistance or for pressure symptoms, but, if these are not encountered, should endeavor to give doses of 30 c. c.

Resistant Cases.—In one form of resistant case there is some obstacle to the proper use of the serum, such as failure to obtain fluid. The management of this type has just been described. When this failure to obtain fluid occurs in young babies, in whom the fontanelle is not yet closed, there is a preferable alternative to injecting the fluid into the spinal canal. The fluid may be injected through the fontanelle directly into the cerebral ventricle. The needle is entered through one lateral angle of the fontanelle, and is directed in the proper direction to reach the ventricle. The fluid is withdrawn and the serum injected precisely as in lumbar puncture.

Frequently failure to obtain fluid is due to certain anatomic conditions, such as the closure by scar tissue contraction of some portion of the lumen of the canal. Such closure is most apt to occur at the foramen of Magendie, and is usually followed, either by repeated "dry taps," or by the obtaining of a very small amount of fluid, in which diplococci soon disappear. Nevertheless, the symptoms persist unchecked, as the process continues to be active above the foramen of Magendie, where it cannot be reached by serum. In any case with persistent symptoms, including fever, accompanied by successive failures to obtain fluid by lumbar puncture, or by small amounts of fluid containing no diplococci, this condition should be suspected.

If the patient's condition is very serious, or growing steadily worse, I believe the cerebral ventricle should be tapped after trephining the skull, and the serum should be injected into the ventricles.

In those rare cases in which a sufficiency of fluid containing no diplococci is obtained, but in which symptoms, including fever, persist, the obstruction may be above the foramen of Magendie, some smaller portion being cut off. In very serious cases, growing worse, injecting the serum into the ventricles should be tried as a last resort.

In another type of resistant case, the use of the serum appears to be attended by no effect whatever. There is neither amelioration of symptoms, nor diminution in the number of microorganisms. These cases can only be explained on the ground that the subspecies of *Diplococcus intracellularis* present is resistant to the action of the serum. Specific therapy will fail in these cases.

All of the above types of resistant cases are rare. In any of them vaccine therapy may be tried.

The Chronic Stage.—The most common and important form of resistant case is that presented by the so-called chronic stage of the disease. In this stage diplococci are persistently absent from the cerebrospinal fluid, the temperature remains most of the time normal or subnormal, but serious symptoms persist. The patient, in this stage, usually remains unconscious, or, with marked impairment of the mentality, may show various paralyses, spasms, or contractions of the limbs, and abnormalities of reflexes, and usually shows persistence of Kernig's sign and rigidity of the neck. However severe his symptoms, his condition remains indefinitely stationary. Such cases are extremely unfavorable for serum therapy. They are to be explained on the ground that the serum has conquered and expelled the *Diplococcus intracellularis*, but the organic damage done to the tissues of the brain and spinal cord is sufficiently great to produce a continuance of symptoms. The symptoms may be due to the contraction of scar tissue, or to the development of hydrocephalus, as a result of the inflammatory processes. While these cases are unfavorable for serum therapy, occasional lumbar puncture should be performed, in the hope that diplococci may reappear, in which case several successive doses of serum might produce some good result. If the amount of fluid obtained at these punctures is large, and under excessive pressure, the evidence points strongly toward secondary hydrocephalus.

While this condition is very unfavorable, I believe that the only hope lies in reducing the intradural pressure as much as possible, in order to avoid increasing injury to the delicate nervous structures. To this end, daily lumbar puncture should be performed, withdrawing each time as much fluid as possible.

Tuberculous Meningitis.—There is no specific therapy in this disease, which is the most frequent of all the bacteriologic types of cerebrospinal meningitis, and is usually regarded as an absolutely fatal disease. It is too rapid to afford any hope of good from vaccine therapy. From time to time cases of recovery from this disease have been reported, including one of my own. In most of the cases some step was lacking in the chain of evidence required for absolutely scientific proof. Nevertheless, there is some evidence that recovery is possible. It is noteworthy that in all these cases of reported recovery early lumbar puncture was performed, and, in some of them, notably in two cases reported from Copenhagen, repeated lumbar puncture was performed.

I believe that, in view of the extreme fatality of this disease, any therapeutic measure which presents the slightest evidence of its value should be tried. In these cases lumbar puncture should be performed early, although the clinical picture presented by tuberculous meningitis is often so indefinite that the physician does not think himself justified in performing lumbar puncture until more definite

symptoms have appeared. In any case in which the first lumbar puncture gives evidence of excessive pressure, with excessive lymphocytes in the fluid, the puncture should be repeated daily until the evidences of pressure are no longer present.

Influenza Meningitis.—This is one of the rarer forms of cerebrospinal meningitis. Judging from the reported cases the fatality of this form is about 75 per cent. I believe it is very possibly far higher even than this.

Flexner, at the Rockefeller Institute for Medical Research, has recently succeeded in producing in monkeys, by the injection of cultures of the bacillus of influenza, an experimental meningitis, which may be used to measure the value of an immune serum. He has further, through inoculation of a goat, produced an antiinfluenza serum, which serum has proven of protective value in monkeys infected with experimental influenza meningitis.

Although this serum has not yet been tried in man in a sufficient number of cases of influenza meningitis to give any statistical evidence as to its value as a therapeutic measure, yet the experimental evidence in its favor is as strong as was that of antimeningitis serum before its widespread trial in man. In view of the high fatality of influenza meningitis I believe this serum should be tried in every case of this disease.

Antiinfluenza serum, for use in cases of influenza meningitis, properly confirmed by the finding of Pfeiffer's bacillus in the cerebrospinal fluid, may be obtained from the Rockefeller Institute for Medical Research. It should be used as early as possible in the course of the disease, and the technique of its administration is the same as that for the use of the serum for epidemic meningitis by subdural injection in connection with lumbar puncture. Until there shall be evidence of its value, bearing on the size of the dose and the frequency of administration, the same method of procedure should be followed as that which has proved successful in epidemic meningitis.

Pneumococcus and Streptococcus Meningitis.—Both of these forms of cerebrospinal meningitis are considered absolutely fatal, and there is no evidence in favor of the value of specific therapy. There also is no positive scientific evidence of any possibility of recovery. We have available for the treatment of these forms of meningitis both serum and vaccine therapy. Both antipneumococcic and antistreptococcic serum and vaccine may be obtained from the manufacturing chemists.

In view of the fatality of these diseases, I believe we are justified in trying either or both of these methods of treatment. These diseases are characterized by such rapid progress that it does not seem as if vaccine therapy offers much hope. If it is to be employed, I believe that a homologous vaccine, made from cultures of the cerebrospinal fluid, should be preferred to stock vaccines. Neither the antistreptococcic nor the antipneumococcic sera have given final proof of value against their respective infections. While there is considerable evidence of the possible value of serum therapy in streptococcus infections, the antipneumococcus

serum has failed in lobar pneumonia. These sera, however, have only been employed by means of subcutaneous injection, and it is possible that, like the anti-meningitis serum, they may be efficient only when given in concentrated form, as can be done in cases of meningitis through intradural injection. I believe that intradural injections of the corresponding antisera should be tried in both pneumococcus and streptococcus meningitis. This method of treatment has been tried in very few cases only, and as yet has shown no evidence of possible value. But, in such fatal diseases as are these infections, any specific treatment holding out any theoretical prospect of good result should be tried, until its efficacy has been effectually disproved.

The difficulty in obtaining evidence is due in the first place to the comparative infrequency of these infections. Also, at the first lumbar puncture when cloudy fluid is obtained, the balance of probability is so largely in favor of infection with the *Diplococcus intracellularis* that it is best to give the antimeningitis serum. If the subsequent laboratory examination reveals the presence of the streptococcus or pneumococcus the physician must obtain the proper serum and go back to the case. By this time, so rapid is the course of these infections, he is frequently too late.

Staphylococcus Meningitis.—This form of meningeal infection should be treated by vaccine therapy. A homologous vaccine made from cultures of the cerebrospinal fluid is preferable to a stock staphylococcus vaccine, but the stock vaccine should be used until the homologous vaccine is ready. The most favorable doses and frequency of administration are yet to be finally determined.

I believe that 100,000,000 bacteria should be regarded as a minimum rather than a maximum dose, and that doses up to 600,000,000 are preferable. The favorable reaction following each injection of vaccine is evidence of the production of some degree of immunity, which is comparatively brief. When this immunity wears off the temperature rises, and the symptoms become worse. The doses should be repeated at these times, which apparently tend to occur every two or three days.

GENERAL AND SYMPTOMATIC TREATMENT

Prophylaxis.—The only question of importance presented by the nursing and care of cerebrospinal meningitis is that of the possible contagiousness of the epidemic form and what precautions should be exercised to prevent the spreading of this disease. Almost nothing is known of the mode of transmission of epidemic meningitis nor of the history of the *Diplococcus intracellularis* outside the body. There is no scientific evidence of value sufficiently conclusive to afford a basis for any definite measures of prophylaxis. The evidence of contagion, pointing toward the definite transmission of the disease from one individual to another, is based on a few striking cases in which a physician or other attendant

upon a case of epidemic meningitis has been attacked by the disease. Such reported cases are so dramatic that they tend to create a false impression as to the contagiousness of the disease.

I do not believe that their frequency, in proportion to the number of cases where, with similar opportunity, infection does not occur, is so great as not to be capable of explanation on the ground of coincidence. While we cannot deny the possibility of contagion, I do not believe that the chances of contact infection are very great. In my records of 109 cases of epidemic meningitis there is no instance in which any nurse, attendant, or member of the same household was attacked. In the Children's Hospital in Boston, where from ten to twenty cases of epidemic meningitis are treated yearly, the patients are not isolated, but are kept in the open ward with other children. Except within the last five or six years, no special precautions to prevent the spreading of the infection were employed. There has been no instance of another patient, or of any nurse or physician of this hospital, becoming infected.

Nevertheless, so long as we know so little of the actual mode of infection in this disease, we are bound to exercise every possible precaution against spreading of the infection. As the evidence points overwhelmingly against the infection being air-borne, it is not necessary to isolate patients, but the same precaution should be exercised as in a disease of the character of typhoid fever. This should include careful sterilization of the hands after handling the patients, and thorough disinfection of all clothing, utensils, and indeed of everything which comes in contact with these patients.

Nutrition.—Under serum therapy the course of epidemic meningitis may, in favorable cases, be short, or it may be prolonged, with severe emaciation. It is best, therefore, in all cases, to prepare for a long course, in which supportive treatment and the maintenance of strength are matters of the greatest importance. While it is essential to give fluid in sufficient quantities, the diet, except in infants, should not consist exclusively of milk. Broths and any of the soft solids which are easy of digestion should be given in addition, and in prolonged cases it is best to gradually increase the number and variety of the articles given, so long as they can be easily digested. In quite a number of cases the patient is so comatose as to be unable to swallow. In this condition lavage should be employed. In infants and young children the passage of the tube is apt to set up a catarrhal inflammation of the mucous membranes. In these cases the tube may be passed through the nose or through the mouth, changing from one to the other when a marked increase of mucous secretion is observed.

General Measures.—The bowels should be carefully attended to throughout. Calomel may be given at the outset and occasionally during the course of the disease. Some saline cathartic should be given daily unless there is vomiting, when the bowels should be kept open by means of daily enemata.

Among the general measures which have been recommended are the application of cold to the head, neck, and spine, the use of baths, and the use of counterirritation.

I have found, when called to cases of meningitis, that the use of the ice bag applied to the head and neck seems to be the universal routine treatment. I do not believe that this measure has the slightest influence upon the course and termination of the disease. It is useful in relieving the single symptom of headache, and should be tried when this symptom is present. While it does no harm, I do not believe that it need be used as a routine, and the physician should be guided by the sensations of the patient, in using it or relinquishing it.

As to baths, the fever of meningitis is rarely high and sustained enough to require reduction by this means. I believe, further, that, in meningitis, cooling baths should *never* be employed. The extreme sensitiveness of the patients makes cooling baths extremely trying and exhausting, out of all proportion to the extremely doubtful benefit to be derived. Warm or hot baths, which have been highly recommended by some authorities, have never presented sufficient evidence of value to warrant their use.

There has been no evidence of value pointing toward any benefit to be derived from counterirritation along the neck and spine.

Drugs.—Three drugs have been recommended as having an influence on the course and termination of cerebrospinal meningitis. These are ergot, iodid of potassium, and hexamethylenamin (urotropin). There has never been the slightest evidence that either ergot or iodid of potassium exercises the least influence upon the lesions, symptoms, course, or termination of meningitis, except the well-known effect of the iodid in syphilitic meningitis.

Hexamethylenamin has been widely advocated in recent literature upon theoretical grounds. It is, or, at any rate, may be, excreted into the cerebrospinal fluid, where it can be recognized by the test for formaldehyde. There is some clinical evidence in favor of this drug, suggestive, but by no means conclusive. I do not believe it can do harm, and the evidence is sufficient to warrant its trial. It is indicated particularly in the fatal forms of cerebrospinal meningitis for which no specific therapy has yet been found, such as the pneumococcus and streptococcus infections. It might be tried in tuberculous meningitis. It is further indicated in those cases of epidemic meningitis which have been described as *resistant* to serum therapy.

Treatment of Symptoms.—The most prominent symptom demanding treatment in cerebrospinal meningitis is pain. When pain is very severe, and can be controlled in no other way, morphin should be used, and fairly large doses are required. One of the dangers in meningitis is depression of the respiratory center from intradural pressure. Such patients appear to be extremely sensitive to the depressing action of morphin, even when given in physiologic doses, and I believe that morphin should be avoided if the pain can be controlled in any other way. The

bromids will often control the pain of meningitis with considerable efficiency.

Delirium, restlessness, and sleeplessness are to be controlled with bromids, trional, sulphonal, or chloral. Of these I believe the bromids are most effective in meningitis.

The most frequent of the symptoms requiring treatment in cerebrospinal meningitis is spasm or rigidity of the extremities. This condition is a positive indication for the use of bromid, which must be given in sufficiently large doses to produce a positive relaxation of the spasm. The continuance of this condition is certain gradually to exhaust the patient's strength. Convulsions, also, are an indication for the use of bromid. If the bromid cannot be retained when given by mouth it must be given by rectum. If the convulsions are prolonged, repeated, and severe, or do not yield to the bromid, chloral must be given in addition. Sometimes inhalation of ether is required for a very severe convulsion.

Stimulation may be required in the course of cerebrospinal meningitis, though I have not seen any instances in which it actually appeared to prolong life. Under the use of the antimeningitis serum stimulation is not often indicated in epidemic meningitis. Stimulants are indicated when the breathing becomes shallow, disturbed, or stertorous, or when the pulse becomes weak, rapid, and irregular.

Of the stimulants, I believe caffen to be the best. Digitalis, or strophanthus, may be tried next in order. Strychnin should not be used in cerebrospinal meningitis, except in those cases of collapse with depression of the respiratory center from increased intradural pressure which are rarely seen following the administration of serum. As to alcohol, the weight of modern opinion is inclined to deny it any value as a stimulant. Nevertheless, I believe it is sometimes a valuable addition to the treatment. Its indications are not those calling for stimulation, but it is indicated as an aid to nutrition in prolonged cases with marked emaciation.

Paralysis following cerebrospinal meningitis, so often seen in those cases of epidemic meningitis which recovered before the days of serum therapy, is seen comparatively rarely now. Treatment of this symptom should be postponed until the patient has recovered in every other respect; then massage, friction, warm baths, and electricity may be begun.

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CHAPTER XIII

LOBAR PNEUMONIA

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Lobar pneumonia is a systemic infection usually associated with febrile disturbances in which large portions of one or both lungs are involved in a croupous inflammation, due, as a rule, to the pneumococcus of Sternberg and Fraenkel, though it may be the local expression of other general bacterial contamination. Bacteremia, toxemia, pulmonary consolidation with consecutive obstruction, and cardiac asthenia form the complex which demands attention in the average case.

It is impossible to offer a *bacteriological classification* of acute pneumonia, because our present knowledge is insufficient, and further because "the whole subject is complicated by the occurrences of double or multiple infections, and by the fact that the bacteriology of many of the specific fevers which are liable to be complicated by pneumonia is uncertain or not known" (Pye-Smith, 75).

Sir Herman Weber (104) in England (1869), Juergensen (43) in Germany, Rodman (82) (1876) and Austin Flint (25) (1877) in this country were pioneers in establishing our modern conception of pneumonia. Rodman's trials were most interesting. He awakened after bitter experience with the treatment of pneumonia to make a full confession of his failures. He wrote: "At last I saw my mistake; I had been treating a local symptom for a general disease; I think now that I might as well treat a case of typhoid fever by attempting to heal the ulcerated bowel, as to treat one of these cases of infectious pneumonia by ordinary treatment."

When the symptomatic and so-called expectant treatment shall be discarded and the dictum of Dujardin-Beaumetz accepted, that "*there is no treatment of pneumonia, there is only a treatment of pneumonics*," an enormous step forward will have been taken.

Jacobi's (41) epigrammatic remark, that "It takes brains to treat pneumonia," and Lees' (50) truthful statement, "*Let it be remembered that every case of pneumonia is a fight for life*," should be kept before the mental vision of the physician, that he may fully appreciate his responsibilities in the prevention and treatment of pneumonic fever.

No disease demands for its conscientious treatment greater sacrifice from the physician and nurse during a limited period, none greater persistence, none greater judgment. No case is so light that it may not ultimately offer a grave prognosis, none so grave that it may not yield and finally recover.

Therapeutic nihilists have done incalculable harm by their unjustified pessimism concerning the treatment of pneumonia; on the other hand, the therapist who treats the disease "expectantly" and "symptomatically," who fails to appreciate the dangers which may often ('tis true, not always) be prevented, will finally find himself face to face with alarming conditions, at a time when his treatment will have been instituted too late.

Butler (10) in his "Twilight Talks" quotes a noted Chicago surgeon who publicly announced that treatment of pneumonia was futile. The lay press was prompt to take up this statement. It is unfortunate that such pessimistic and sensational literature should add fright to infection and should strengthen the belief in the minds of many that "pneumonia has become a synonym for fatality," a conclusion unjustified and one which results disprove.

Statistics.—Hospital statistics, which it may be assumed offer the only collective information available which shows the results of treatment, are misleading and often unjust. Neglected cases are found in all services and are numerous; many alcoholics are brought to our wards moribund; not a few cases treated from the beginning of the infection in private homes without adequate nursing finally enter the hospital wards to die; all of these cases showing a high mortality are included in published statistics, and are received by the profession and lay world as representing the actual results of our fight against the disease.

In my recent service at St. Joseph's Hospital in Syracuse we received into our wards thirty-four cases of pneumonia, of which eight died; of this number five died within the first twenty-four hours following admission. Our published mortality was $23\frac{1}{2}$ per cent., whereas the results of treatment, or more properly the mortality of cases receiving hospital care during more than twenty-four hours, presented a more hopeful picture. Of the remaining twenty-nine cases only three died, and of these two were chronic alcoholics—a mortality of only $10\frac{1}{3}$ per cent. These statistics are repeated in the wards of all general hospitals year after year, and lead the thoughtful to the conclusion that the truth concerning the effect of treatment can be reached only after a thorough analysis of statistics and the grouping of cases.

In spite of the discouraging statements concerning the influence of treatment on pneumonia made in the recently published works on therapeutics, the profession may accept the dictum that the rational modern treatment of pneumonia, including cautious nursing, does materially influence the prognosis of the disease and leads to the saving of many lives.

Division of Cases for Therapeutic and Prognostic Purposes.—For therapeutic and prognostic purposes the following division of cases is justified:

I. Cases which, if cautiously piloted without special therapy, but with reasonable care, recover.

II. Cases in which no therapy is of use; these are fatal from the beginning, overwhelmed by toxemia and associated infiltration.

III. Cases which for a time hang between life and death, in which rational therapy accomplishes much (Wyss, 112).

Requisites of Treatment.—The problem is: "How can this troublesome condition be relieved without injury to the patient? How can the general nutrition be kept upon a high level?" *The treatment of all pneumonics must be individualized.* Whatever the treatment of the disease, whatever prophylactic measures are adopted, the fact remains that Wyss's contentions are correct, that the "organism must be cautiously studied that we may interpret its own protective powers, what processes within itself are lacking or inadequate, which of these require sturdy support, how the receding strength may be prevented by the application of such measures as have no analogues in the body, but must not be injurious." *The requisites of every rational therapy* are, "therefore, to do that which is expected of the defender of a threatened fortress—he must have exact knowledge of the situation, must know its strength and its vulnerable points, and the correct alignment of its forces, must throw himself into the conflict, using all his ammunition, because he is not fighting an enemy who alternately approaches and retreats to lengthen the battle, but a keen antagonist who must surely and quickly exhaust his strength." In the treatment of pneumonia we take into account:

I. The malignancy of the infecting organism.

II. The effect of toxemia and associated mechanical obstruction on the cardiovascular system.

III. The resistance offered by the patient.

IV. *The extent of the pulmonary and associated lesions.* These do not always bear a direct relation to the severity of the disease.

It is not unusual to find severe and overpowering toxemia with limited lung infiltration. The mechanical disturbances produced by pneumonia first show themselves with the fever, due to associated general toxemia. The heart offers the greatest danger in the course of pneumonia. Most pneumonics die of cardiac asthenia, therefore the physician's duty in every case is so to treat his patient, more particularly the heart, as to give it the strength which the added burden demands so far as his art permits. He is to do nothing which can in any way injure the heart of the pneumonic or rob the patient of resistance. These statements cannot be accented too forcibly or too often in considering this subject. To follow a course of absolute therapeutic nihilism with these facts before us is unjustifiable.

There is no case of pneumonia which ought to be left to itself, none which can with safety be neglected. Rigorous medication is not always needed. The therapist of to-day is no longer limited to the administration of drugs. There are so many details for which he is responsible, which all cases demand, and which it is his duty to supervise, that the vigilance of the attendant ought not to be relaxed until the patient is well beyond the febrile period, and free from physical signs, with heart strength fully restored.

Pneumonia, Old Age, and Childhood.—The ability of children to resist pneumonia is surprising; during early life the prognosis is usually good. In old age, on the other hand, the disease is in many hospitals and during many seasons the principal cause of death. In old age the organs become more independent of one another than during early life. "They suffer separately and the various lesions to which they may become subjected are scarcely echoed by the economy as a whole." In our consideration of the differences in the pneumonia of adult life, we find that in old age the latency of disease is often surprising, and death may be sudden and unexpected in the aged, who were about as if nothing were the matter with them. In all, old and young, the association of diseases of the heart, lungs, kidneys, or other separate systems, which handicap the functions of organs in any way, adds enormously to the danger of pneumococcus infection; this is particularly true of metabolic faults and advanced arteriosclerosis.

PROPHYLAXIS

Because of the ubiquity of the pneumococcus without known illness, and the further fact that pneumonia is a communicable infectious disease, unquestionably mildly contagious, it is important that every means be employed to destroy, so far as it is possible, all secretions and excretions coming from the infected body, including the sputum, and to limit contact with all who can in no way benefit the patient. Every unnecessary occupant of the sick room robs the patient of oxygen which he needs, and adds carbonic acid to vitiate the air. So far as possible, all pneumonics should be isolated. Old and young who have once had pneumonia are subject to recurrence of the disease. Pneumococcus toxemia is often depressing during a long period; recurrences are frequent, because immunity is short-lived. Such subjects should be placed in favorable surroundings in a suitable climate during cold and damp seasons; the body should be protected against exposure without encouraging a hypersensitive state by overdressing or by the overheating of dwellings; this is necessary after all acute infections of childhood and old age. Chill and fatigue are provocative factors of disease—fatigue is particularly inviting to pneumonic infection. Children who have a tendency to bronchial catarrh should sleep in the open air protected by sufficient clothing. The woolen

bag nightdress and the warm bed are necessities in connection with out-of-door sleeping in these cases. To increase the resistance of these patients their lives must be cautiously arranged in all details, while diet and hygiene become our special care. In the susceptible a single error may prove exceedingly expensive.

The inmates of public institutions are entitled to intelligent hygienic treatment, that the ravages of the disease may be prevented. It is in these places that disease-producing organisms are likely to abound. Rodman (82) recognized the importance of the proper ventilation of all public institutions, including prisons; he recognized the value of the "ounce of prevention." "Whitewashing, burning coal-tar, cleanliness of prisoners and their bed-clothing, fresh air circulating through the cells, with the abolition of the cell houses and the substitution of places built for human beings to sleep, revolutionized the scourge in which the mortality was often over 40 per cent."

The pneumococcus does not survive long outside the body; properly treated, it is destroyed in an hour or two. In sputum kept warm and moist, however, it may thrive, proliferate, and retain its virulence so long as fourteen days.

The pneumococcus and all germs causing pneumonia are ubiquitous and find a habitat in the mouths and in the saliva of normal subjects. Durck (17) found that "the lungs of children who did not die of pneumonia and lungs of domestic animals contained the diplococcus and other bacteria. Cultures of bacteria blown into the lungs of healthy animals caused no pneumonia; dust; however, did, and so did a mixture of cultures and dust. It is, therefore, not the presence of the pneumococci alone, but their fixation and their activity in generating toxins, which cause morbid tissue changes." These are important facts for us to consider in the application of prophylaxis.

Treatment of Sputum.—All sputum coming from the pneumonic must be thoroughly disinfected. *Finkler's method* is safest and best. A solution, three per cent. each, of caustic potash and borax, colored with a trace of phenolphthalein, is made, and into this the sputum is deposited and dissolved by it; to this is added a solution of hydrochloric acid and mercuric bichlorid of sufficient strength and quantity to decolorize the red alkaline solution, when the cup is emptied. The burning of the sputum is also efficacious; sputum should never be carelessly deposited, but should always be collected in containers which permit of its disinfection and destruction. Besides Finkler's method, many use carbolated water or lysol solutions. All disinfectants should be kept out of the way and should be used only by the nurse or some one specially charged with this function.

Oral Cleanliness.—Oral cleanliness is exceedingly important at all times and in all individuals. By proper attention to the mouth, nose,

and tonsils we destroy pathogenic organisms which, if left untouched, often cause grave infections, including pneumonia. *The tonsils are recognized as the port of entry of microorganisms.* These organs demand special attention. It is safe to recommend their removal if they show the slightest abnormality; this is particularly true in early life.

A very valuable and efficacious mouth wash which the author has used with satisfaction is the following:

R	gm.	
Creosoti	0.6	(grs. x)
Tinct. myrrhæ	10.	(ʒiiss)
Sodii bicarbonatis	8.	(ʒii)
Glycerin.	32.	(ʒj)
Aquæ Menth. piper. ad.....	240.	(ʒviii)

To cleanse the nose only weak solutions are borne without causing irritation, preferably alkalies.

Nurses and Attendants.—Nurses and attendants should protect themselves while in service by the frequent use of nasal and mouth washes, and should maintain their health at par by getting sufficient sleep, fresh air, and plain but sustaining food.

Public Health.—The state owes the individual a duty, which includes the scientific *ventilation of public buildings*, schools particularly, and the cleaning of streets and pavements in a way which will reduce the dust nuisance to a minimum.

Correction of Predisposing Conditions.—*Abnormalities and obstructions* should be removed from the air passages of children. The masses should be educated to an understanding of the influences of *alcoholic excesses* and dissipation in inviting infection of all kinds, particularly pneumonia. Supposedly *trivial ailments of the respiratory tract*, particularly the fauces, and the alimentary canal should be treated with a view of preventing possible graver pulmonary complications.

Carriers.—The pneumonic should be instructed during his convalescence that the infecting agents may find a resting place in his air passages during an indefinite period after relief from symptoms, and that he may be an active “carrier” of the infecting microorganism.

Disinfection.—All linen and clothing coming in contact with the patient should be thoroughly disinfected. The room after the termination of the disease should be subjected to thorough cleansing and fumigation.

Prevention of Secondary Pneumonia.—Forchheimer wisely calls attention to the prevention of secondary pneumonia following other infections, particularly during convalescence, by all possible precautions.

Ether pneumonia is in all probability a preventable disease. All who are subjected to ether anesthesia should, if the stomach is not known to be empty, be thoroughly lavaged, certainly if the operation is to be long

or upon the intestinal tract. Mouth and nasal passages should be cleaned before the administration of the anesthetic.

The possible prevention of complications in the pneumonic, based upon the action of *hexamethylenamin*, has led to its administration. Some claim that empyema, pericarditis, endocarditis, and otitis media have been prevented by its routine use. In the Massachusetts General of Boston and Presbyterian Hospital of New York results have been favorable in connection with the occurrence of pericarditis in those taking the drug. Cases not taking the drug developed the complication in four to five per cent. at the Massachusetts General, and one and five-tenths per cent. at the Presbyterian Hospital. The Massachusetts records show that otitis media occurs in four per cent. of the non-hexamethylenamin cases; in no instance in which the drug was administered.

Cleanliness.—Hands should be kept clean; children as well as adults should keep money and unclean objects out of their mouths.

Education.—Positive and printed directions, which will make clear the nature and dangers of infection and the methods of its prevention, should be given the heads of all families. The *campaign of education* which is being waged in all parts of our country will ultimately reap its reward in the success which it deserves.

TREATMENT

GENERAL TREATMENT

An intelligent *nurse* ready to make sacrifices, quiet and refined, with good poise, is as necessary as the intelligent physician in the care of the pneumonic. The patient should be provided with a suitable *bed* in the best ventilated room which the house or hospital affords (preferably in the open air, with a southern exposure, where this is not contraindicated). The bed should be thoroughly warm when the patient gets into it. The best bed for protracted illness of any kind is the plain single hospital bed, made sufficiently high, with a well-made mattress and stiff woven wire springs. The standard hospital bed is six feet six inches long, thirty-six inches wide, and twenty-six inches high; if necessary for the comfort of the attendants, this may be raised on blocks. It should stand, if possible, in the middle of the room; the sheets are to be smoothly laid and kept so; the protecting rubber and draw-sheet should not be omitted. *The patient should not be burdened by unnecessary covering.* He is laboring from the beginning of the disease to overcome mechanical obstruction in the lung, and is in no condition to lift unnecessary weight or coverings with each inspiration. Considering the rapidity of respirations, the importance of this fact at once becomes clear. Children are often made the victims of oversolicitous but deluded mothers and uneducated

attendants by failure to appreciate the truth of these statements. *No pneumonic should be handicapped in his fight for air and light. All unnecessary furniture and trimmings should be removed from the room.* The temperature of the room should be from 60° to 65° F., rarely 68° F.; the aged and feeble and very young may require the latter degree of heat.

Open-air Treatment.—If the patient is in the *open air* it does not matter how low the temperature, so long as his body is kept comfortably warm, his head covered, his respiratory organs free to breathe the unadulterated tonic air.

The open-air treatment of pneumonia is not an innovation. With increasing refinements of practice and the educating of the masses to the understanding that the modern therapist includes in his armamentarium nature's methods of curing disease, always natural and rational, and a lowered mortality, the public is ready to accept our conclusions and the individual has less fear of pure cold air. Every case of pneumonia, unless there are positive contraindications, should be treated in the open air or in a room in which the supply is sufficient to meet the demands of his case. Foreheimer (29) says, "I do not hesitate to affirm that the fresh-air treatment is the most valuable contribution that has been made for the treatment of pneumonia." The experienced are ready to verify the truth of Foreheimer's emphatic statement.

Modern hospitals are built to supply the need of infection requiring the open-air treatment. Most hospitals have either a room or a ward which can be easily transformed to meet the needs of the pneumonic, while the home, however humble, has a room or space which will permit of the treatment either by improvising the window tent, easily accomplished, the removal of window sash, or such other modifications of the surroundings as are necessary.

Once the patient has been brought under the tonic and exhilarating effect of the pure, fresh air he is a convert, unless robbed of consciousness. By the giving of fresh air vitality is sustained or strengthened, the work of the heart is reduced, that organ gets more sleep because its periods of rest are prolonged, the patient breathes slower. The effects are promptly apparent, and, in many cases, even in alcoholics whom we have treated in our hospital services, the delirium was reduced, sleep was increased and restful. The influence on temperature is favorable, while the cough is lessened. Blood pressure is heightened by exposure to the open air. At Bellevue Hospital (Meara, 55) it has been noted that there was a rise of ten to twenty mm. Hg promptly after removal to the open air, which was as promptly lost after a half hour in the ward, though the latter was well ventilated. The rise returned on return to the open air. It was further noted that the rise was more marked when the temperature of the inspired air was low. I have had similar experiences in my hospital service and private practice. *Less medicine is needed and Nature is assisted in her own effort to save life when the*

patient is in the open air. Pure cold air accomplishes more than oxygen inhalation. The lower the temperature the greater is the tonic effect of the inspired air. Brannan (7), who, as trustee of four of the largest hospitals in New York City, speaks authoritatively on this subject, unreservedly approves it after a sufficient trial, and, after commending it for adult pneumonia, says: "I have often on my visits seen a dozen cribs on an open balcony on a bright cold winter's day and with not a sound coming from the children. It was an impressive contrast to the fretting and wailing of the ordinary infants' ward."

"Conditions exist outdoors that tend to a more rapid heat loss than indoors. The lower temperature of the outside increases humidity, and the greater amount of air movement gives us a more rapid loss of heat by all the methods—radiation, convection, and conduction—than inside, and on the face of things it seems to me this is the real differential effect the outside air has as compared with the inside air; that is, it increases the loss of heat, which in turn calls upon the organism to supply a greater amount of heat in order to keep up its body temperature, and this in some as yet occult way stimulates metabolism" (Phillips, 73). Whatever the theory, we know that in practice the open-air treatment of pneumonia is rational and a valuable adjunct.

Position in Bed.—Position in bed is important. As a rule, it is best to turn the patient from side to side, but let him get into the position in which he breathes easiest, remembering always that hypostatic congestion must be discouraged. This is done by localizing the lesion, and noting the ease with which the patient breathes in the position which he of his own volition takes. *If such position is not associated with increase of respiratory embarrassment or evidences of engorgement in dependent parts of the lung, leave him undisturbed.* Patients of all ages promptly learn to make themselves as comfortable as they can be made and place themselves accordingly. Volland (103) of Davos believes that patients should be kept at absolute rest; he leaves the patient wherever he finds him, does not move him from his back, prohibits the slightest movement, uses the bed-pan, cold to the head and chest, no bath; makes no examination which requires the slightest movement on the part of the patient, and insists upon this absolute rest throughout the acute stages of the disease.

The *hearts* of pneumonics from the beginning to the end of the disease are taxed by any movement of the body or any of its parts, speaking or any effort; any increase of the heart's action unnecessarily provoked adds to the danger of the disease, and should be cautiously avoided. The pillows should not be too soft, for if they are the patient sinks into them and seeks to raise himself at short intervals. Because of this fault neither feather pillows nor such covers should be allowed. The hair pillow is preferable. Combination suits make examination difficult; the old-fashioned nightdress, thin, kept from wrinkling, is most comfortable, and

makes it easy for the attendant to watch the abdomen and thorax without greatly disturbing the patient.

Examination of Patients.—The patient should be given a thorough physical examination on the first, second, and third days of the disease; the extent and location of the consolidation once cleared, it is useless and injurious to move the patient from side to side, or worse to raise him in bed for further examination. Most important is the thorough examination of the *heart and pulse*, as well as the extremities, at each visit. If after the third and until the seventh day the posterior thoracic regions demand examination, the flat phonendoscope may be used, or, if necessary, the position may be changed by the “draw-sheet” without the patient’s effort. The *temperature of all pneumonics should be taken in the rectum!* respiratory embarrassment is increased by the holding of the thermometer under the tongue; this is particularly true in the later stages of the disease. The raising of patients in hospitals for examination by medical students in sections is unnecessary and injurious! a single demonstration of percussion may be given by the teacher, after which the patient, remaining on his back, may be drawn to either side of the bed for mediate or intermediate auscultation, the study of voice sound, fremitus, etc. Judgment tempered with humanity on the part of the teacher and student will be needed to conserve the strength and resistance of these patients.

Care of Body.—The average case does not require tubbing or packs, but should be kept clean and comfortable by surface bathing with warm water, under covers, morning and night. If there is excessive perspiration, cloths dampened with warm alcohol may be used, then rough towels for surface friction, all without exposure of the patient. The use of carbolated talcum powder to all folds and often to the surfaces adds materially to the general comfort. The *ice-cap* frequently relieves headache without the addition of medicine. The extremities of these patients should be kept warm; for this purpose hot water bags or bottles well covered to prevent burning, or an electrotherm, may be used.

Chill.—If the physician is called during the *chill* (this does not often happen), he should surround the patient with hot bottles or water bags and may give a goblet full of hot water with thirty drops each of aromatic spirits of ammonia and compound spirits of lavender; if this is not at hand, a cup of hot tea or coffee will be found efficient. During the initial chill the hot mustard foot bath adds greatly to the patient’s comfort, and cuts the chill short. This should be given with the patient in bed, and need not disturb him.

Pain and Cough.—Early in the disease the *pleuritic pain and cough* are annoying, with more or less malaise, headache, and myalgia. Under these conditions .03 ($1\frac{1}{2}$ grain) *codeia phosphate*, subcutaneously administered, with .6 (10 grains) aspirin may be given. These remedies may be

repeated in two hours. If the pains are not relieved, .01 (gr. 1/6) *morphia* sulphate may be given hypodermically; the codeia will, however, prove sufficient in many cases. Added relief is given by *strapping* the affected side, carrying the adhesive plaster well beyond the median line in front and behind, overlapping these to give added strength. Prompt relief often follows the use of the ice-bag or the compound mustard liniment, 8 gms. (3ij); the latter is poured on absorbent cotton, held against the painful side by means of the bandage during fifteen to twenty minutes; this does not blister, it reddens the skin, and acts as a powerful counterirritant. No counterirritant should be used which opens the surface for further local or general infection. During the following twelve to twenty-four hours *pain* is best controlled by either *morphia* in small doses, or from ten to fifteen drops of the tincture of opium and ipecac, given every three, four, or five hours, according to the urgency of the symptoms. The addition of the ipecac is helpful. In children small doses of tincture of opium and ipecac (.06-.12, one to two drops), according to the age of the patient, will prove of great value, while the effect on the general condition of the patient, and associated symptoms in the adult and in the child, is usually favorable. The relief of pain accomplishes several important objects: it promotes expectoration, relieves congestion, assists the pulmonary circulation, eases respiration, relieves depression, and rests the patient.

Gastrointestinal Tract.—In all cases of pneumonia it is wise at the very beginning to empty the gastrointestinal tract thoroughly, and throughout the course of the disease to bear in mind the effect of an *overfull* or *dilated stomach*. Inactive intestines add to existing obstruction, also to respiratory embarrassment and cardiac asthenia. *Calomel* in divided doses should be given at once, either .006 (1/10 gr.) every five minutes until ten such doses are taken, or four powders each containing .03 (1/2 gr.) every fifteen minutes, with .12 (2 grs.) sodium bicarbonate. The calomel should be followed in the course of one hour by a saline, preferably Rubinat, Pluto, or Apenta water; for children and hypersensitive adults the liquid citrate of magnesium may be given.

While the *emptying of the intestinal tract* by calomel with a saline does not influence the onward march of the disease, the patient is more comfortable because of its use, and the breathing is less labored so long as the diaphragm is not pressed upon by a dilated stomach or intestines filled with gas.

In all cases the urinary secretion demands watching and a liberal supply of water is a necessity; to this may be added sodium bicarbonate or ammonium compounds with more or less salt, which help to keep the urine alkaline throughout the course of the disease.

The administration of potassium nitrate in full doses causes sodium

chlorid to reappear in the urine in a few hours, and to continue present as long as it is given. Hughes reports remarkable effects from the use of the nitrate, temperature begins to fall and gradually reaches normal. Physical signs remain for a few days; there was no crisis in the cases reported by Hughes.

Delirium.—The delirium of the average case, *non-alcoholic*, is easily managed by occasional doses of codeia or morphia; occasionally chloral hydrate, .6 to 1 gm. (grs. 10-15), with 2 gms. (30 grs.) of Hoffman's anodyne in sufficient water may be given. There are some who are opposed to the use of chloral in pneumonia. Guarded, as I suggest, I have never seen bad results in properly selected cases. A weak, dilated heart, with or without myocardial degeneration, and extreme circulatory embarrassment, contraindicate the use of chloral. Such cases will do better with hypodermics of *morphia* in small doses, or *hyoscin*. The latter drug must be given in the smallest doses which quiet (1/100-1/150 grain, .0006-.0004 gm.). It often increases unrest and delirium. If hyoscin is efficient, the first dose usually demonstrates that fact, and is followed by a quiet sleep. Under no circumstances should it be repeated if delirium and insomnia persist, or are increased after its use. It does not require a large dose of morphia to quiet the patient; often small doses suffice and produce narcosis out of proportion to the size of the dose given; the sleep is likely to be profound. In the delirium and unrest of cases in the terminal stage, the timely use of morphia is often life-saving. In occasional cases, where morphia is not tolerated, veronal, trional, or medinal may be tried. Cerebral symptoms are an expression of underlying infection, often pneumococcic meningitis; with the appearance of these symptoms we consider among causative factors the changed body temperature, the heart condition, respiratory embarrassment, and we are not to overlook the possibility of alcohol as a factor in cases where its habitual use was unsuspected.

DIET

The problem of the *feeding* of pneumonics, because of the limited course of the disease, is not so complicated as it is in the infections of longer duration. It is important to protect the patient without overtaxing the organs of digestion and circulation. The already enfeebled and overtaxed heart should not be called upon to perform unnecessary effort in the process of digestion.

There is a lowered nutritive activity during the development and progress of the disease; there is also a lowering of the functional ability of the organs of digestion to perform the usual amount of work; and to these factors we must add the waning power in the "oxygenating capacity of the system, due to a blocking out of a part of the air space by the pulmonary inflammation" (Potter, 74).

Wolf and Lambert (110) in their study of protein metabolism in pneumonia reached the following conclusions: "Cases of milder type show a smaller loss in nitrogen and sulphur than do those of a more severe grade. The daily loss in nitrogen on a diet adequate to protect a resting individual from nitrogen loss may be from 20 to 25 gms.

"During the period of hyperpyrexia excessive amounts of creatinin are eliminated. This is followed during convalescence by a subnormal excretion of creatinin; this is taken to indicate the endeavor on the part of the organism to repair the losses sustained during the height of the toxemia." Large amounts of creatinin are excreted in the severer pneumonias. Wolf and Lambert found that this loss is seen particularly during the time of the greatest nitrogen loss. During convalescence creatinin disappears from the urine. "During hyperpyrexia, especially in cases severely toxic in type, unusually high amounts of undetermined nitrogen are excreted. In some cases over 5 gm. of nitrogen derived from uninvestigated substances are found in the urine." These experimenters found that sulphur excretion runs parallel with that of nitrogen, and cases which progress unfavorably seem to show an excessive destruction of protein containing much sulphur.

The available diet should be almost entirely liquid in character; it should be light, should not excite cough in swallowing, nor should it ever be given in sufficient quantity to cause marked distention of the stomach. An abundant and free supply of *water* is the first requisite in every case. Small quantities of food given at relatively short intervals are preferable. The demands of the patient average between 2,400 and 3,000 calories per diem. The aim should include the raising of "the intake and utilization of proteid material as nearly up to or a little beyond the normal standpoint as possible" (Potter, '74). The total of food given should include from 65 to 95 gms. of proteid per diem.

Milk, eggs, broths, liquid cereals, and fruit acids, with the addition of alcohol where specific indications justify its use, will in the majority of cases meet all indications for diet.

In administering *milk* it is absolutely necessary to know whether the stomach is able to digest it without holding it in large curds to irritate and add to the danger of the disease. I have seen patients whose respirations and pulse were promptly increased after taking raw milk, who were able to digest the milk when acidulated after the method of Rudisch (88), which includes diluted hydrochloric acid one part, two hundred and fifty parts water, and five hundred parts milk. In practice one-half teaspoonful of dilute hydrochloric acid in one pint of water is slowly poured into one quart of raw milk and brought to a boil with constant stirring. This method makes the milk palatable to many, and, for these, more readily digested than normally. Milk may be pre-digested, diluted with vichy, seltzer, or lime water, added in accord-

ance with the taste and requirements of the case. Rubner (87) has shown that one liter (one quart) of milk contains seven hundred calories. The average milk sold in our cities probably gives 640 calories to the quart (Meara, 55), or 20 calories per ounce. We cannot, therefore, depend on milk alone to nourish the pneumonic, as the amount of the liquid required to give the needed calories (2,400-3,000) would be out of proportion to the patient's digestive ability; therefore, cream, barley, sugar, sugar of milk, rice water, or oatmeal may be added, and these are usually well borne. Water-ice, ice cream, cup custards, orange juice with or without whipped albumen, lemonade, grapefruit, grapes, kumyss, matzoon, zoolac, and often buttermilk are enjoyed and promptly digested; vegetable soups are permissible.

Coffee.—The average adult is stimulated by a cup of coffee or tea given twice daily. In the late stages of the disease strong coffee per os, and at times per rectum, does yeoman's service.

Alcohol.—If the stomach is intolerant, alcohol is demanded. Jürgensen gives all of his pneumonics alcohol; he concludes that alcohol is a remedy which conserves body tissues against degeneration in pneumonia; it creates heat by its consumption which the body itself must produce in its absence. It is promptly assimilated and requires no digestive work. He gives wine, particularly red wine, from the beginning. The Germans always use it before and after a bath given to reduce temperature. Binz contends that alcohol does not raise the body temperature either in health or disease; it rather tends to lower it.

If it is made clear that in the individual case the prescribed diet without alcohol is insufficient to meet the caloric requirement or if there are other indications (as heart weakness, etc.), then alcoholic preparations, as heat-producing foods, should be added. Alcohol is not necessary in all cases, but the experienced know that there are cases in which it is absolutely indicated. Pneumonics show great tolerance for alcohol, and it is in all probability used as a food as well as a stimulant. The individual case offers its own indications, and these must be reported by the cautious nurse and interpreted by the discreet physician. Diluted alcohol, whisky, brandy, tokay wine, champagne, and during convalescence Rhine or Mosel wines offer a selection from which choice may be made.

If proteid animal food increases intestinal fermentation, or if by it a culture medium in which bacteria proliferate is supplied, to the detriment of the patient, as is shown by discomfort, a change will be needed, and vegetable broths, already suggested, may be substituted; these added to alcoholic preparations may occasionally bridge the patient over the critical period. "Owing to the greater ease of digestion, and the higher nutritive value of the animal class, this class is more frequently called into service than is the vegetable class alone. Owing to lower nutritive and higher caloric value and antibacterial influences, the vegetable class can often be utilized to greater advantage" (Potter, 74). Potter fur-

ther emphasizes the fact that "judgment and skill must be exercised in changing from one class to the other, lest nutritive activity be allowed to fall to too low an ebb, and the heart muscle be starved to death." *Alcoholic subjects demand alcohol during the active period of the disease.* Without it we often face collapse. Effervescent drinks should be cautiously used; fresh cold water or ice pills are preferable. To quench thirst orange juice, raspberry vinegar with water, diluted phosphoric acid with syrup of raspberry, the latter so much used in Germany, may serve this purpose. During convalescence ripe fruits are grateful, as are vegetable purées, calf's foot jelly, omelet, and junket. Let the return to a liberal diet be postponed until the fever has subsided and the patient is on the road to recovery.

HYDROTHERAPY

The *fever* of pneumonia is one of Nature's provisions to destroy the pneumococcus; at the same time it is likely to be an expression of the virulence of the toxemia. As a rule, the temperature in pneumonia does not call for active interference. The pneumococcus cannot long thrive in a temperature of 104° F. Cases with high temperature from the beginning, in which there is a free and frank development of the disease, often run a shorter course and are more likely to terminate in crisis than are those in which the temperature is low, gradually rises, without the typical picture of the "honest pneumonia." High temperature with marked remission during even a limited period daily requires no antipyretic treatment, as a rule. Fever persistently above 104° to 106° F. demands attention both in children and adults. Higher temperatures are not often encountered; when present, they require hydrotherapeutic measures as the safest method of treatment, if there are no contraindications. With high temperatures there are often evidences of heart weakness, which influence us materially in the selection of the method of overcoming hyperpyrexia. Cold is not well borne in the presence of heart weakness. Often the hot sponge bath under covers, one extremity after the other, with cold to the head, reduces temperature without causing fatigue or shock. This method is particularly valuable in the pneumonia of early life and with patients who are restless and who show increasing heart weakness.

To pack an adult is a great task, and should not be undertaken without considering fully all of the indications of the case. I have had better results with this method with children than with adults.

The English use the "air bath"; a tent arrangement is placed over the bed; the patient is lightly covered; he is then surrounded by fairly cold air. If necessary bags of ice are hung within the frame.

Ice bags to the thorax are often of value in reducing hyperpyrexia and

relieving pain. There are "pneumonia bags" in the market made to fit the thorax for this purpose. A drainage tube makes the melting ice more refrigerant than the ordinary rubber bag containing ice water; the bag may be placed outside the robe; it relieves pain as it reduces temperature.

Ice and cold locally applied "exert an undeniable temperature effect on the deeper structures" (Schweinburg, 90). Schweinburg claims a lowering of temperature when ice is placed on the surface. Measurements were taken in the mouth, vagina, the bowel, and pleural cavity to prove the contention. Cold to the thorax and to the head in pneumonia does positively affect the heat-regulating centers, and should be used in well-selected cases. There is often a prompt response in the mitigation of symptoms referable to the central nervous system. The patient besides having less pain is quieter and less irritable. The Leiter coil has frequently proved an agreeable substitute for the ice bag. In the very young and very old cold locally should not be used; in these cases heat is preferable. Whenever ice bags are used, one of these should be applied over the consolidated area.

Rubbing the surface with ice with proper stimulation has occasionally relieved hyperpyrexia in desperate cases. Ice bags should be removed whenever temperature is within the limit of safety, unless they are needed to relieve pain.

Immersion into the cold bath should remain untried if other methods are efficacious, or if, in the presence of high temperature, the pulse remains good and there are no evidences of more than the ordinary wear from the fever. When the patient shows evidences of pulmonary edema, increasing heart weakness, cyanosis or an approach to it, or labored respiration, in spite of high temperature, the indications referable to the heart must be first met, and these do not often include or allow the full bath in the average case. There are many factors to be considered before using the full cold bath in pneumonia which require quick judgment. The profession is agreed that tubbing in pneumonia is not followed by the average good results obtained with the same treatment in typhoid fever. The Germans use the full bath oftener in the treatment of pneumonia than do the Americans. The cold bath with effusion gained a firm hold in Germany after the appearance of von Jürgensen's article many years ago. Liebermeister's (51) treatment includes cold baths (70° to 80° F.) in the beginning, 85° F. toward the end of the febrile period. These are of ten minutes' duration and are given, when the temperature of the patient is 104° F. or above, between seven p. m. and seven a. m. Liebermeister gave no baths during the daytime, but cold sponging, and by this method reduced his hospital mortality to 16.5 per cent.

Experiences in this country have not led the profession to follow the routine use of tub baths in the treatment of pneumonia. Baths are not only useless but injurious if the disease is progressing favorably.

Strümpell's (96) statement that "almost every bath has some disagreeable feature" is justified.

Preëxisting heart lesion, myocardial degeneration, or coronary disease offer positive contraindications to the use of the bath in pneumonia.

The blanket pack (Kellogg, 44) followed by the cold mitten friction occasionally answers every purpose. In the asthenic type of the disease the wet sheet often produces sleep in the midst of active delirium.

In my hospital service and private practice I have usually decided in favor of cold sponging with the use of cold compresses or ice-bags to the thorax and have rarely been disappointed; patients have not revolted as they invariably do when immersed. Cold to the skin stimulates sensory nerve endings, to the general circulation and to the vasomotor nerves of the pulmonary vessels it is a powerful stimulant, also to the respiratory center and to the cerebrum; in fact, the total effect on the nervous system has usually been salutary. For the general practitioner in the average cases the cold sponge and cold compress or ice-bags properly applied offer more than any other hydrotherapeutic measure, and with less danger and inconvenience to the patient.

There are many cases in which heat does more than cold, and we are not surprised to find, considering our own experiences, that Ortner (64) became a convert to the use of the hot bath in the treatment of pneumonia. He recommends that it be used early for the purpose of encouraging perspiration, believing that toxins are thus eliminated. The effect is increased by the drinking of large quantities of fluid. In the malignant types of toxemia Ortner recommends the hot bath with intravenous saline injection. In this he was anticipated by Henry (36) years ago. During the cold season, when pneumonia prevails, if the open-air treatment or an approach to it is carried out, hydrotherapy will not often be required; during the heated term when we see less of the disease occasional cases may demand it.

MEDICINAL TREATMENT

While this article considers in detail the treatment of the many indications which present during the course of pneumonia, and suggests the use of a variety of remedies from which choice may be made to meet these, there will be, in the practice of every rational therapist, many cases in which he will be able to pilot his patient to recovery with a minimum of medicine. This should be his aim.

Quinin and Its Salts.—The enormous doses of quinin given by the Germans thirty years ago are no longer used. At the present time, prompted by the experiences of Petzodl (71), Henry (37), and Solomon Solis Cohen (12), the *quinin and urea hydrochlorid* is rapidly gaining a place for itself in the therapy of pneumonia. Cohen has recently called the attention of the profession to the use of this double salt of quinin. He was prompted by Gailbraith's (33) use of quinin in large doses (1904).

Cohen uses the most active salt, quinin and urea hydrochlorid, as advised by Petzold for malaria, hypodermically, in his hospital service. As a rule, from 6 to 10 gms. (90 to 150 grs.) are given in divided doses in from 48 to 60 hours. The initial dose is from 1 to 1.6 gms. (15 to 25 grs.), followed in three or four hours by a second injection and perhaps by a third and more, according to the effect and urgency of the symptoms. Following the use of the remedy there is no cinchonism, in spite of the fact that smaller doses, .3-.6 gm. (5 to 10 grs.) are given by the mouth for several days after the use of the remedy hypodermically.

The temperature and pulse fall gradually and proportionately; the respiration more rapidly; there is a tendency to restoration of the normal pulse-respiration ratio. Blood pressure is either unchanged or increased. Cohen says: "The complete clinical picture so far as regards the rational symptoms (objective and subjective) is thus favorably changed." Patients are more comfortable after the injections, pulse is full and strong, respiration easy, cough is materially relieved, delirium favorably influenced. Lysis between the fifth and eleventh day was found in the majority of cases; there was no crisis. Physical signs are uninfluenced. The invasion of new areas again demands recourse to the injections. Empyema was not prevented. The most striking improvement in respiratory symptoms, cardiac vigor, holding and improvement of blood pressure, led to the logical inference that the results are chemical and anti-toxic. Cohen's mortality does not exceed ten per cent. There are no bad results attributable to the drug. The use of the double quinin salt does not exclude the administration of other remedies to meet indications, and should be followed by the tincture of ferric chlorid. The urine should be kept alkaline by sodium bicarbonate or ammonium compounds. Cohen says: "I would not like to be called to treat pneumonia without this important resource at hand." Petzold (71) considers the use of quinin hypodermically as a specific and considers it the most valuable of the recent contributions to the treatment of pneumonia. He uses quinin hydrochlorate. Henry subscribes enthusiastically to the quinin injection treatment for pneumonia, using hydrochlorosulphate of quinin because of its greater solubility.

My experiences in several cases encourage me in believing that the double salt of quinin and urea is a remedy of great value in the treatment of pneumonia and should be used in most cases. While the disease is not aborted and lung changes progress uninfluenced the patient is made more comfortable, the temperature lowered, the pulse slowed, and he seems better able to withstand the disease because the associated sufferings are so materially relieved by the use of the drug.

The double salt of quinin and urea hydrochlorid is soluble in water; a fifty per cent. solution in sterilized water is most convenient. Of this solution from one to two gms. (15-30 drops) may be administered hypo-

dermically, followed by a second injection in from three to four hours, or, as Cohen suggests, perhaps by a third and even fourth injection at some time within the first twenty-four hours, according to results. On the second day this plan of treatment is repeated, and on the third, if necessary. From 6 to 10 gms. (90 to 150 grs.) are given in from forty-eight to sixty hours; after this time smaller doses, .3-.6 gm. (5-10 grs.) may be given daily by the mouth for several days. It is wise to follow Cohen's directions, which are as follows: "The syringe is filled with a fifty per cent. solution of the quinin and urea salt in sterilized water, and the needle is inserted deeply through the skin, previously painted with iodine, into a muscle. The syringe is emptied thoroughly, so that the solution does not drop upon the skin when the needle is withdrawn. The point of puncture is sealed with iodoform-collodion." No bad results follow these injections made in the manner recommended.

Caffein.—Caffein should be given, beginning during the early days of the disease, because of its effect in bracing the heart and the assistance which it gives in anticipating, so far as we are able to do, the effect of toxemia on the heart muscle. The most soluble salt should be used, and preferably hypodermically; caffein sodium benzoate in doses of from .03 to .09 gm. ($\frac{1}{2}$ to $1\frac{1}{2}$ grs.) every three, four, or five hours, as indicated. When face to face with severe cardiac asthenia, the dose must be larger. Reference will be made to its use under such conditions in considering the treatment of the cardiac toxemia of pneumonia.

Camphor.—Seibert (91) of New York (1909) insisted that twenty per cent. *camphorated sterile oil* should be injected in large doses as soon after the initial chill as possible. Recently he has recommended the use of thirty per cent. camphor oil. The remedy is repeated every twelve hours, giving ten c. c. (3iiss) of the prepared oil hypodermically to every one hundred pounds of body weight. In cases of bilateral pneumonia and severe toxemia, these injections are repeated every six to eight hours. Seibert believes that the camphor destroys the vitality of the pneumococcus in the blood current, and that small doses are without effect. His results are encouraging. The Germans have for years used camphor as a routine remedy in the treatment of pneumonia, more particularly for the weakness of the heart.

Creosote Carbonate.—Favorable results sometimes follow the use of *creosote carbonate* or *creosotal* (Van Zandt, 101, and W. H. Thomson, 97). Van Zandt claims to have reduced the mortality to five per cent. by the use of creosote carbonate. Thomson uses creosotal and reports but one death in eighteen cases, these including three double infections and two alcoholics, one having delirium tremens. He administered 1 gm. (15 grs.) every two hours while the patient was awake without bad effect on the kidneys. The cases are likely to terminate by lysis. The dose of creosote carbonate is .45 gm. ($7\frac{1}{2}$ grs.) every three hours for several

days, continuing after the temperature is normal for a limited period; otherwise there will be irregular rises. Sajous' (89) treatment consists in the free use of saline solution with creosote carbonate from the very beginning, to replace the sodium chlorid which is consumed with abnormal rapidity in pneumonia; normal osmotic properties are preserved and undue viscosity prevented. The creosote carbonate "enhances the bacteriolytic and antitoxic power of the blood and enables the blood to reach the nidus of infection with increased rapidity." He gives 0.6-1 gm. (10-15 grs.) in capsule every two or three hours.

Guaiacol.—*Guaiacol*, either for its effect on the lung lesion or temperature, is mentioned to be condemned. When used as an antipyretic, its effect is produced at a loss of the patient's resistance. The same may be said of *pilocarpin*.

OXYGEN

The literature bearing on the value of *oxygen* in the treatment of pneumonia is contradictory, but presents some evidences in its favor. The fresh-air treatment of the disease now almost universally adopted has materially reduced the necessity of using the remedy. There always will be a large number of cases of pneumonia which will not be treated under favorable conditions, and for these oxygen must be considered.

Many have never, in spite of the favorable reports included in medical literature, been fully satisfied that oxygen is efficacious in the treatment of the disease, i. e., that it causes the disappearance of cyanosis or modifies that symptom, or that it has improved subjective symptoms, strengthened or relieved the overwrought heart. Osler (65) contends that it may be "positively harmful," and makes the statement that "it has often proved irritating, and experimentally does actually produce inflammation of the lung." Forchheimer (29) holds: "On account of the continuous high temperature, toxemia, and accumulation of carbonic acid in the blood, the respiratory centers may become paretic. Under these circumstances oxygen inhalation is invaluable." He suggests that the disappearance of cyanosis, slower pulse, increase in depth of respiration must be a guide for quantity and frequency of its use.

Ortner (64) favors the use of oxygen under conditions already mentioned, and adds that this conclusion is confirmed by the reports of Michaelis and Leyden (59). Lees (50) believes that it "must be given first place among cardiac stimulants," that "it relieves cyanosis and thus, by promoting the pulmonary circulation, it gives strength to the heart." He further adds: "Though it gives relief, I never saw it save a life." He suggests the use of alcohol vapor and blood letting in properly selected cases with oxygen, and concludes that its action is on the cardiac and vascular centers in the medulla, rather than on the heart itself.

When using oxygen it will be wise to apply the hot water bag to the spine, thus preventing the prostration due to rapid oxidation of blood and tissues.

Oxygen must be freed of chlorin before it becomes safe; otherwise it irritates the membranes of the air passages. It must pass through a wash bottle before it is inhaled. Ozone may be added to prevent deterioration. Saline infusion, with timely venesection or local abstraction of blood by leeches or wet cupping, is of value in connection with inhalation of oxygen, as well as such other depletion as will relieve the heart by thoroughly emptying the splanchnics, preferably concentrated solutions of salines, administered early in the morning when the stomach is empty.

The writer's experience strengthens the belief that fresh air contains as much, if not more, oxygen than can be absorbed into the blood by its artificial administration. However, occasionally under its use the heart beats more regularly and slower, the patient becomes less restless and may fall asleep. Better results will follow the open-air treatment.

In asphyxia, in which toxemia is associated with a pronounced mechanical element, Raymond and Maissonet (77) have used hypodermic injections of oxygen with remarkable results. The authors believe that this method of treatment is superior to the inhalation of the gas.

"The technique is very simple. The skin of the outer surface of the thighs is first disinfected with tincture of iodine, and a sterilized needle is then pushed into the subcutaneous cellular tissue. Care must be taken to be assured that the needle is not in a vein, to avoid gaseous embolism. To the needle is then attached the tube from an oxygen cylinder. This tube should have an interruption of a glass tube containing a little sterile absorbent wool, which acts as a filter. Then the gas is allowed to bubble gently under the skin. The injection is kept up for about twenty minutes. The quantity of gas injected is not measured."

SPECIFIC TREATMENT

The *object* of specific treatment is to increase the resistance of the individual by the introduction of remedies which directly or indirectly through the blood current supply antibodies, or by their presence in the blood in some way unknown to science favorably influence cell life, increasing its defensive powers. This is the most important question with which the profession is to-day occupied.

In considering the efficacy of any new remedy many factors are to be weighed before accepting as final reported results, whether favorable or unfavorable. The overzealous are blinded by conditions which are materially affected by factors peculiar to the endemic. They are likely to forget Nature's overpowering influence, the self-limitation of the dis-

ease, and the atypical character of many pneumonias. Statistics of pneumonia are too frequently valueless for reasons already mentioned in this article. It is important to know whether the reported cases were mild or severe, whether typical or complicated, in considering any new method of treatment. The unsuccessfully treated cases are not likely to be reported; for these reasons the reports of a single observer are of little value. Specific treatment of pneumonia is *sub judice*, but sufficient has been written and accomplished to justify fuller reference to the subject, in a work of this character, than has been given in the modern treatises on therapeutics. I shall consider:

- I. Antipneumococcic serum.
- II. Pneumococcus vaccine.
- III. Autolyzed pneumococci (Rosenow, 86).
- IV. Leukocytic extracts (Hiss, 39).
- V. Chemoimmunology (Lamar, 48).
- VI. Metallic ferments (Robin, 80).
- VII. "Irritating drugs to cause abscess fixation" and consecutive phagocytosis.

I. Antipneumococcus Serum.—Antipneumococcic serum as used therapeutically is supposed to introduce into the blood of the patient a serum rich in ready-made antibodies with the hope of throttling the infection without effort on the part of the tissues to produce these.

The most recent utterances on the subject of serum therapy are from Römer (84). "Welcomed with exaggerated hope; thrown overboard after the first bitter disappointment, antipneumococcic serum must now find a place for itself in human therapy." "Just as the meningococcic and streptococcic sera, so has the antipneumococcus serum a just claim for recognition, and this it will acquire for itself." Römer holds in favor of the ultimate success of a serum for the treatment of pneumonia, because of the fact that in no acute infection are protective bodies so promptly formed in the blood as in this disease. Pane (66) in 1898 elaborated a pneumococcic serum which has been largely used in Italy. He is convinced of its value in man, and some other Italians have considered his serum a specific (Fanoni, 22). Desara-C'oa (14) believes he has reduced the mortality of the disease at least one-third by the use of the Pane serum.

Fraenkel (31) in 1886 obtained some degree of immunity in rabbits which had been artificially infected with the pneumococcus. The Klempner brothers (47) (1891) were pioneers in the field of serum treatment of pneumonia. Foa and Emmerich (27) (1892) were the first to treat infected animals with the antipneumococcic serum.

Until Römer of Würzburg in 1902 (84) commenced a series of studies of pneumococcus immunity, the object of which was to obtain a

serum for the treatment of *ulcus corneæ serpens*, a pneumococcic infection, the treatment of pneumonia by a serum was not seriously considered by the profession. Merck (58) of Darmstadt elaborated the serum of Römer, which Pässler (67) of Leipzig has since tested at his clinic with encouraging results. In the preparation of the Römer serum horses, cattle, and sheep are used. Each of these is treated with a large number of cultures obtained directly from the human subjects, hence the serum is polyvalent. Cultures of this kind possess a high degree of virulence for man, though they possess but little virulence for experimental animals. Römer is forced to test each batch of serum cautiously on pneumonia patients before it is available for therapeutic use generally. A serum is now obtained from horses which can be tested by animal experiment. The Royal Institute for Experimental Therapeutics at Frankfort a. M., over which Ehrlich presides, has undertaken this work. Its strength is expressed in units of immunity (U. I.). If a dose of 0.01 c. c. of the serum is able to protect a white mouse against 10-100 times the lethal dose of live pneumococcic culture, the serum contains 1 U. I. in each c. c.; it is called a simple or normal serum. The serum as now ready and on the market contains 20 U. I. in 1 c. c. (Merck). The consensus of opinion has been that the serum is not harmful, and there has been no dangerous endotoxemia, neither is there likely to be because of its absence at the time of the crisis of pneumonia, when endotoxins are unquestionably overwhelmingly present. The Germans, who have used the serum most, report that the injection is followed by general improvement; it is not contraindicated during any stage of the disease. The temperature is not materially affected immediately after its administration; six to twelve hours later there is a fall of temperature, and in some cases a pseudocrisis. In no case was there collapse. In the majority of cases after the injection of the serum the disease remained confined to the lobe diseased. Infiltration of the lung already under way was not halted. Pässler (68) reports four cases of associated severe edema of the lungs in which the physical signs disappeared and his patients made prompt recoveries. Resolution of infiltrated lungs was not hastened by the treatment. In none of Pässler's cases treated with the serum was there empyema. With improvement of the general condition the circulatory conditions, including blood pressure, showed relief, and this in severe cases. Meningeal symptoms were also relieved. Leukocytic counts remained unchanged, as a rule.

The writer, after a thorough consideration of his own experiences and those to which he has referred, concludes that the effect on the mortality of pneumonia by the treatment with pneumococcic serum cannot be decided at present from a consideration of the limited material at his command. As antipneumococcic serum is not antitoxic, it does not produce in animals an extracellular toxin, antitoxic immunity cannot be produced. It is antibacterial, an argument in favor of its

use early, if used at all. McPhedren (54) and Wolf (108) both argue in favor of the bactericidal powers of the serum; the former holds that to be of value it must be given before marked bacterial proliferation and that would really mean at an impossible time "before it is possible to make the diagnosis."

Sill (93) gives encouraging reports of the treatment of *pneumonia in infants and young children with a polyvalent serum*. The serum which he used was a composite obtained "from diphtheria-immune horses that have been subjected to a prolonged and progressive immunization with a mixed culture of the pneumococcus taken from several strains of pneumococci from a number of cases of pneumonia in different stages and of different degrees of severity." Diphtheria antitoxin in antibacterial sera favors leukocytosis, increases phagocytosis, and thus favors destruction of the pneumococcus in the blood current and tissues. Ten c. c. of serum should be injected at various intervals, depending on the symptoms and effect. It has been shown that serum sickness is prevented when the remedy is given in concentrated form. Horses should supply the serum.

There are various strains of pneumococci, and a stock serum of one variety may have no effect against the onward march of one or more of the other varieties. If, after the further trial of antipneumococcic serum, failure proves to be its fate, it will probably depend on the absence of antitoxin in the serum, injection after the disease is too far advanced, and the impossibility of determining the causative organism in each case.

A conservative conclusion would justify the use of a serum or some form of bacterial therapy early in the majority of cases of pneumococcemia. When there is a low leukocytic count the advice given in the preceding sentence is sound and should certainly be followed. Circulatory embarrassment and pulmonary edema do not contraindicate bacterial therapy, neither does lowered vitality, the pneumonia of the aged, or alcoholism argue against serum therapy. I commend it in all grave infections where an autogenous vaccine is not at hand.

To an adult 20 c. c. of the antipneumococcic serum may be given. If the improvement is evanescent then the dose is to be repeated. This dose may be repeated if necessary during three or four days.

But little attention has been given to the consideration of the *prophylactic uses of the serum against pneumonia*. It may be used for this purpose; the injection of 200-400 U. I. is recommended, particularly in old people where the development of disease is feared, more particularly where hypostatic congestion accompanies infection.

Fuller and more recent results of serum therapy can be found in the fifth volume of this work.

II. Pneumococcus Vaccine.—The pneumococcus vaccine is a sterilized suspension of bacteria of known numerical strength. The fluid used to suspend the organism is a one per cent. sodium chlorid solution containing one-half per cent. of carbolic acid. McDonald (53), the pioneer

in this work, produced artificial crises in rabbits, infecting them with the pneumococcus. These infected rabbits were inoculated with a vaccine made from the same strain with which they had been infected. McDonald was able to produce a crisis and recovery at will. In favor of the vaccine it must be reported that control rabbits on whom the vaccine was not used died. The most authoritative résumé on vaccine therapy is the discussion of this subject by the Royal Society of London (98), opened by Sir Almroth E. Wright (111) (1910): "The fundamental principle of vaccine therapy as I conceive it is to exploit in the interests of the infected tissues the unexercised immunizing capacities of the uninfected tissues" (Wright). In considering the limitations of vaccine therapy in pneumonia, as in other infections, the unbiased statements of Wright are self-explanatory. He contends that vaccine therapy can be applied only after an exact and complete bacteriological diagnosis has been made; it requires acquaintance with bacteriology and a knowledge of dosage. The responsive powers of the patient become a powerful factor; an efficient lymph stream is needed through the foci of infection, and there is no security against relapse until the infection has been eradicated, and finally it is claimed that the dose of the vaccine in "not inconsiderable percentage of cases must be controlled by measurements of the opsonic index." Leary (49), on the other hand, says: "The opsonic index has little value for controlling treatment of the acute infections, and among these more particularly the general infections." Harris (35) found that from fifteen to twenty million pneumococci might be given in pneumonia without harm. A fall of temperature was produced in a few hours; more frequently it rose again, but not to the same level, and it was necessary to repeat the inoculation once or twice. The inoculations are indicated in pneumonia before the nervous mechanism of the circulatory system suffers much inhibition. Harris states that "a pneumococcus vaccine in the sequelæ of pneumonia and other pneumococcus infections is as sure as that of staphylococcus in boils." He made the further statement in the discussion to which reference has been made that the time was not far distant when pneumococcus vaccines would prove to be as valuable to pneumonics as diphtheria antitoxin had proved to be for diphtheria. Latham in the same discussion held that there can be no question as to the value of the vaccines in chronic pneumonic infection, but that our experience does not justify so dogmatic an opinion on the effect to be produced by vaccination against acute pneumonia. The collective investigation of Stoner (95) bearing on vaccine therapy gives expression to the opinion held in this country. He reports 155 cases treated with 135 recoveries, mortality of 12.9 per cent. Among these are Leary's (49) 83 cases, including 34 alcoholics, with a mortality of 9.7 per cent. Of the 34 alcoholics 6 died, a mortality of 17.7 per cent. Of the remaining 49 cases 2 died, mortality 4.08 per cent. Hare (34) makes the state-

ment: "Recent observations seem to show that pneumococcus vaccines possess marked curative properties when properly administered in acute pulmonary infections of this organism."

"Crisis occurs earlier; the course of the disease is favorably influenced, and there are marked relief of toxic symptoms and a lowered vitality," according to Leary (49), Harris (35), Wilcox (107), Morgan (60), Allen (1), and Wolfe (108). Different strains of pneumococci cause the disease, hence one stock preparation cannot be efficient in all cases. Dosage is difficult, and will often depend upon the individual giving the treatment. The opsonic index cannot, according to Morgan, be used as a guide to resistance and dose. Early in the disease the opsonic power is never high. Good results may follow large doses, while the same doses in other cases fail. Morgan recommends that we begin with minimal doses and "look for minimal effects." We do not as yet know what is taking place in the immunizing process.

In the treatment of pneumonia the element of time is important, hence a suitable stock vaccine, if vaccine therapy is selected, should be used at once. The autogenous vaccine represents the ideal of bacterial therapy. Relying on the sputum for cultures, it is not unlikely that we may not get pure cultures of the pathogenic organism. Blood culture is too often negative to be of value in many cases. Lung puncture is an extreme measure and does not always give the needed culture. It seems to the writer that, if we decide upon vaccine therapy, we will in the majority of cases be compelled to use a stock vaccine and at once proceed to produce an autogenous vaccine.

Vaccine therapy is not to be instituted without an understanding of its urgent necessity, and an appreciation of the associated responsibility. Men with thorough laboratory training must prepare the vaccine; this requires the prompt coöperation of laboratory with bedside workers for whatever autogenous or heterogeneous vaccines are used; these are of no value if the disease is advanced, or in the presence of profound toxemia. Stock vaccines should not be given into careless hands—without correct diagnosis they may be productive of great harm.

Vaccine therapy of pneumonia ought not to be condemned because it fails to check malignant infection after the organism is robbed of resistance. Vaccines are of value in delayed resolution of the consolidated lung, in which there is but little remnant of the original general infection (McPhedren, 54).

The average dose of 35,000,000 bacteria every twelve hours may be administered (Egbert and O'Neil, 19). Frequent injections at short intervals are recommended by some authors. The effect of the initial dose should be watched to decide the time of repetition. If the temperature rises from 1° to 3° F., it will be safest to give no more vaccine during twenty-four hours. If the dose is repeated in the presence of increasing physical signs, it should not be increased. The larger dosage

(50,000,000) is best suited for chronic cases. In favor of polyvalent vaccines the argument is advanced (Van Cott, 99) that there is "less danger in the negative phase than in the rapid increase in both bacteria and toxins involved in the loss of initial time; with this increase the somatic cells are prone to become benumbed with toxins and lose their reactionary powers." The polyvalent vaccine promises in well-selected cases to provide a prompt means of stimulating resistance, more particularly the formation of antibodies. It does not preclude the use of an autogenous vaccine when finally elaborated. The question arises, "Is the value of a vaccine dependent upon autogeny, or virulence of strain?" If Van Cott is correct in his conclusions that "the really important factor would seem to be virulence of strain," the use of the polyvalent vaccine is certainly justified.

Cases in which there is mixed infection, streptococcus or bacillus coli communis, demand such a vaccine; thus a number of cases of lobar pneumonia have been recently reported by Niles and Meara (63) due to micrococcus catarrhalis and bacillus coli communis. The proper use of polyvalent vaccine is harmless, and may prove time-saving in well-selected cases, but, like all other vaccines, it is of no use when used late.

III. Autolyzed Pneumococci (Rosenow, 86).—Rosenow's original article based on the injection of autolyzed pneumococci in twenty-five patients with lobar pneumonia is encouraging. I am privileged to include Rosenow's more recent experiences, which have been transmitted in a personal communication to the writer, and seem worthy of inclusion in this article. His report follows: "The work on autolyzed pneumococci as antigen has been continued along experimental and practical lines. The conclusions published June, 1911, have been verified, and the hope that pneumococci from which the larger part of the toxic substance has been removed may stimulate antibody formation earlier and more promptly, and thus be a real help in combating pneumonia, has been realized to a satisfactory degree.

"In the early cases 75 per cent. show what seems to be a definite alteration in the course of the disease. The temperature drops by lysis inside of forty-eight hours, the patient seems more comfortable, pulse slower, etc. In approximately 25 per cent. of cases even early injection seems not noticeably to modify the course of the disease. In most of the latter, bacteriologic study of the sputum showed the presence of a large proportion of other bacteria. When the injections are given later in the course, the results are much less striking.

"In a series of one hundred patients with pneumonia at the Cook County Hospital, fifty untreated and fifty alternate cases treated, irrespective of the age, severity of symptoms, day of the disease, etc., the mortality of the former was 48 per cent., while in the treated cases the mortality was 30 per cent. Nearly all the cases were advanced beyond

the fourth day of the disease, and the fact that so many were alcoholics and the total mortality so high speaks in favor of the view that the treatment has real curative value. The number of cases, of course, is very small to draw conclusions. From what I have seen, I feel that the detoxicated pneumococci are of real help in combating pneumonia, a means of active immunization which surely does no harm, and, from all the facts which I can find, is of definite help. The importance of using it early cannot be too strongly emphasized. After the mechanism of immunity is paralyzed from an overwhelming infection, no amount of stimulation can do much good. This I feel is the chief reason why the mortality in the cases of the Cook County Hospital hasn't been made lower than it now stands. I feel that it is too early to make any very positive statement; all I can say is that it looks hopeful. Don't understand me to mean that I feel that the 'real cure' will be found along this line, but that this method will lower the mortality when properly used I cannot help but feel certain of."

IV. Leukocytic Extract (Hiss, 39).—The profession is much interested at the present time in the experimental work and therapeutic trial in connection with the injection of leukocytic extract. The principle of the treatment is based on the fact that a high leukocytic count, as a rule, offers a good prognosis in pneumonia, that the added leukocytes make the individual more resistant to pneumococcus toxemia.

The assumption is that the phagocytic power of the leukocyte of the pneumonic is less than that of the normal individual. Hiss has extracted these substances and has used them in a diffusible form to supply material to the infected organism, to heighten phagocytic action, and offer greater protection against toxemia. Experiments upon animals show that susceptibility and immunity to pneumonia infection are measured by the phagocytic power of the leukocyte of the animal employed. Pneumococci taken from the blood of pneumonics were injected intraperitoneally in animals by the Wright capillary pipette method, and these in turn were treated with leukocytic extract. Hiss and others conclude that, as a result of these intraperitoneal inoculations and treatment with leukocytic extract, the severity of the disease was modified and that the lesions were more localized. Floyd and Lucas (26) used an aqueous extract of leukocytes of rabbits, obtained from pleural excitation, injected subcutaneously into the buttocks, thigh, or back. Small children were given from 5 to 10 c. c., severe cases 15-20 c. c., three or four times in twenty-four hours. The effect depends largely upon the time of using the extract. The mortality was $12 \frac{1}{5}$ per cent. We cannot commend or oppose this treatment; the material used is too small to permit of conclusions. All reports show that it is not injurious to the patient. The experimenters are agreed that there was improvement in most cases, that the recovery was hastened, toxemia diminished, and mortality lowered; the patients seemed

more comfortable. In a series of cases treated by the extract there was a lower mortality than in a series of untreated cases. Floyd and Lucas concluded that "where a case of pneumonia is treated early with the extract of leukocytes, and full and frequent doses given where they are required, this agent may prove of considerable therapeutic value."

V. Chemoimmunological Studies in Pneumococcus Infection (Lamar, 48).—Recently it has been suggested that definite chemical substances produced within the body take an active part in the defenses against infecting organisms, as well as the specific antibodies of the blood serum and phagocytes. A recently published article by Richard V. Lamar (48) is particularly inviting and encouraging. In the introduction of this article by Simon Flexner (24), the latter calls attention to the fact that substances extracted or expressed from leukocytes are not only bactericidal, but also hemolytic, differing from the antibodies in being thermostable and alcohol soluble. Noguchi has shown that "the activity of these extracts depends upon their content in certain higher unsaturated fatty acids or their alkaline soaps," and Klotz has demonstrated these soaps in inflammatory foci. Autolysis of tissues within the body frees unsaturated fatty acids derived from the cleavage of "lecithin-like complexes"; large quantities of the latter, also of the fatty acids, have been extracted from areas of pneumonia in its end stage. The autolysis of leukocytes in an inflammatory focus yields the "fatty complexes" and finally the fatty acids and soaps; thus the disintegration of the leukocytes and tissues produced by local infection may assist the body in nullifying the latter by means of these bacteriolytic chemical substances. It was suggested by Flexner that the decrease in the number and the virulence of pneumococci in the stage of resolution is only partially the result of phagocytosis, *and that some other agent* must be present to account for their change. Lamar's investigations showed that largely diluted solutions of the alkaline oleates do not appreciably change the shape or proliferative power of the pneumococci, but they do produce profound changes in their structure. Pneumococci treated with sodium oleate become more subject to autolysis, shown by the "rapidity and the perfection of the process of self-digestion" with accompanying lysis. The lysis of the soaped pneumococci is incomplete with normal serum, but perfect with an immune antipneumococcic serum. It was noted that when normal serum was employed "the surviving pneumococci subsequently multiply either in the test tube or in the animal body, in the latter case producing fatal infection." Lysis is complete, however, when immune serum is used; there is no multiplication, the test tube mixture is sterilized, and the inoculated animal is protected from infection. These experimental results are mentioned to stimulate further experimentation along these lines. Lamar concludes that the application of the included principle to the treatment of lobar pneumonia becomes a pressing question, that the ap-

plication of the treatment to local pneumococcus infections to which serum, soap, and boric acid mixture can be directly applied seems to offer promise. In an editorial (*New York Medical Record*, 62) the editor says: "There can be no doubt that the investigations of Lamar open up a virgin field in medical research, and, significant as are the results that he has already obtained, one may confidently anticipate still greater discoveries in the near future."

VI. Metallic Ferments (Robin, 80).—The French, particularly Albert Robin, have claimed brilliant results from the injections of colloidal solutions of the metals—platinum, gold, silver, and palladium (Musser and Norris, 61). Robin treated 14 cases, giving hypodermic injections representing the active principles of the metals, obtaining "chemically very distinct results, i. e., increase of urea, increase in the coefficient of nitrogen utilization, increase of uric acid, and free elimination of indoxyl." Thirteen of Robin's cases recovered. The theory which has fortified this treatment is based upon the belief that the introduction of the metal increases the protective powers of the individual patient to fight the infection. Observations with the remedy in this country are not yet sufficiently mature to justify conclusions. Thiroloix gave injections of colloidal silver with satisfactory results.

VII. Irritating Drugs to Cause "Abscess Fixation" and Consecutive Phagocytosis (Fochier, 28; Lepine, 52; Dieulafoy, 15).—Fochier noticed that in certain infections (puerperal and others) sudden improvement not infrequently follows pus accumulation in the iliac fossæ, the breast, a joint, or elsewhere. He believed that "the appearance of a local abscess or cellulitis seemed to have a curative action." He gave it the name of "abscess of fixation." Fochier treated cases of puerperal infection successfully by the production of analogous abscesses by subcutaneous injections of essence of terebinth. Lepine and Dieulafoy have applied this principle to the treatment of pneumonia in several cases with apparent success. "An injection of 15 minims (1 c. c.) of essence of terebinth, i. e., 60 minims (4 c. c.) for four injections, is given by means of a sterilized syringe, in the subcutaneous tissue of the outer surface of each thigh and of the deltoid region of each arm." Acute pain is produced which continues for two hours. Edema, inflammation, and suppuration follow, with associated leukocytosis. The abscesses are opened, the pus in Dieulafoy's cases was "amicrobic." He concludes that the treatment deserves serious consideration; that "it should be reserved for patients who are suffering from grave pneumonia in which gray hepatization is imminent."

TREATMENT OF CARDIAC TOXEMIA

The treatment of the cardiac toxemia of pneumonia is often discouraging, because it is likely to be overwhelming and malignant.

To prevent the onset of circulatory embarrassment and to relieve this condition when present in acute pneumonia requires the breaking away from the empirical practices of the past, and the acceptance, as indications for treatment, of the conditions which clinical and bacteriological experiences have made positive. *We are not to limit ourselves to the consideration of the heart alone; we must know the condition of the peripheral vessels, particularly the arteries.*

Riegel (79) demonstrated by sphygmographic tracings that most infections are associated with reduced arterial tension. Rosenbach (85) emphasizes the importance of the vasomotors in experimentally induced infectious endocarditis, and Buchard (9) demonstrated the baneful influences of bacterial poisoning on the vasodilating centers. It remained, however, for Romberg (83) to make a series of experiments and to associate these with clinical data. These have done much to place the treatment of the circulatory failure in pneumonia upon a scientific basis. His experiments with the *Bacillus pyocyaneus* and the pneumococcus of Fränkel, made to determine the relative importance of the heart and vasomotor system in the production of the circulatory failure in infections, proved that the circulatory symptoms, considered to be due entirely to heart weakness, are intimately associated with demonstrable change in the vasomotors. *"We must consider with the heart weakness the weakness of the vasomotors, and with the cardiac paralysis that of the vasomotors also."* Pässler and Romberg (69) reported a series of experiments which serve to prove the relative importance in the production of the so-called heart weakness in pneumonia, of the heart itself, and of the vasomotor system. Experiments made with the pneumococci and the bacillus pyocyaneus, in which rabbits were inoculated, proved conclusively that the vasomotors were weakened and showed evidences of paralysis. These experiments carried to a logical conclusion prove that *the toxins exert their baneful influences upon the vasomotor centers in the cord.*

In pneumonia, for a time, the arterial tension is kept up to the necessary height by an excited heart action. In this country Van Santvoord (100) has done excellent work in this same field. His sphygmographic tracings were taken in eighteen cases of pneumonia; these confirmed the conclusions of the German observers.

In formulating a rational treatment of the changed circulatory conditions, we must keep in mind the association of an enfeebled heart with dilated peripheral vessels.

Primarily there is toxemia. This leads to cardiac asthenia with marked changes in the right half of the heart, far-reaching degenerative changes in the muscle, heart clots, and vasomotor paralysis. To this must be added the obstruction in the pulmonary circuit. Fortunately the toxemia is short-lived, but its effect on heart and vessels is malignant,

and when these suffer the treatment must be radical, prompt, and sustaining.

The indiscriminate use of such remedies as lower the vitality of these patients, while they reduce temperature, is injurious and interdicted. All antipyretics, except cold or heat, which suddenly depress temperature do so at the expense of vital force, and are apt to rob the patient of needed resistance, and may cause sudden collapse. Nothing should be given which, at any time in the course of the disease, acts as a cardiac depressant. Let the treatment from the beginning be constructive, not destructive.

In spite of the authoritative statement of von Jaksch (42) that coal-tar preparations "are nervines and indispensable," we strongly oppose their use in pneumonia.

Nitroglycerin.—The indiscriminate use of *nitroglycerin* as a heart stimulant is fallacious; it widens vessels and the heart is given an added tax. It has been demonstrated also that the vagus is paralyzed; thus inhibition is removed from the heart by large doses of the drug, and it is assumed still further by Brunton (8) that the blood loses its power of absorbing and conveying oxygen, conditions which should be prevented.

Nitroglycerin may have its uses in overcoming peripheral obstruction where the arteries are tense, sclerotic, or narrowed, against which the heart is laboring (see Blood Pressure). This condition is occasionally present in pneumonia of the aged, and may be associated with interstitial nephritis. Experience with these cases has been very unfortunate; with slightly lowered pressure due to the drug, and a slow pulse during a short period, the heart finally fails and the patient dies. In pneumonia where we already have paralysis of the vasomotors, nitroglycerin is a dangerous drug, in spite of the fact that one or two authorities of note have recommended it in this condition to relieve the overtaxed and dilated heart.

Veratrum Viride.—The author has never seen a case of uncomplicated pneumonia materially relieved or controlled by *veratrum viride*. In strong plethoric subjects with high blood pressure and a great deal of pulmonary congestion Sajous believes that *veratrum viride* and the bromids in full doses relieve the patient. He believes the drug depresses the vasomotor centers, forces more blood into the splanchnic area, while the peripheral organs and lungs are depleted.

In chronic nephritics suffering from pneumonia, with advanced arteriosclerosis, aortic insufficiency, likely to be of the afebrile type, the author has occasionally relieved discomfort by the use of the drug.

The routine use of *veratrum viride* should be discouraged; the reduction of temperature and heart force by its use is fraught with danger and has not the slightest influence on the pneumonic process; this becomes more clearly pronounced during its use; neither does it reduce the febrile period. Sidlo (92), who made thorough observations at the Duchek Clinic, concludes that "Minor variations in the febrile symptoms are proved to depend not on the action of *veratrum viride*, but on the character and amount of the inflammatory process in the lung." The disease increased, diminished, and terminated to all appearances just as if nothing had been given. Vomiting, collapse, and other unpleasant effects often follow the use of the drug.

Caffein Sodium Benzoate.—Caffein sodium benzoate, 0.03-0.06 gm. ($\frac{1}{2}$ to 1 gr.), is the one drug given by the writer in all pneumonias from the beginning as suggested under General Consideration, because of its bracing and stimulating effect without doing harm. It is best given hypodermically. This salt of caffein is soluble. When face to face with marked cardiac depression, acute or threatening collapse, the dose must be materially increased, giving as high as 0.12 gm. to 0.36 gm. (1 to 4 grs.) with the diffusible stimulants as often as four to six times in twenty-four hours.

I have not infrequently tided patients over the critical period by the rectal injection of three or four ounces of strong *coffee*, followed by the Murphy drip of normal saline and coffee, continued during several hours at a time, if the rectum continued tolerant. *The usual dose of caffein as given by most physicians is too small to produce results.* Caffein stimulates the vasomotor centers in the medulla, it raises blood pressure by causing contraction of the vessels; this action is not accompanied by a slow pulse, but by some acceleration; the action on the muscular fibers of the heart, however, causes more powerful contractions besides increasing urinary secretions. The fact that the blood is in a measure depleted of its water by the action of caffein on the kidneys and that the supply is replenished from the tissues makes it necessary to balance the loss by the drinking of abundant water, by the rectal drip, or, in threatening cases, by saline hypodermoclysis. Henry is a pioneer in the use of saline hypodermoclysis, his results have often been paralleled by the writer in serious cases (normal saline 3, ad 500) (50 grs. ad one pint).

Digitalis.—Prominent therapeutists differ widely in their views on the value of *digitalis* in the treatment of pneumonia. In this country the method of Petresco (72) of Budapest, by which the disease was claimed to be aborted by large doses of digitalis, has not found favor. He recommended the daily use of from four to eight gms. (3i-3ii) of the powdered leaves of digitalis. Forchheimer, who gave this method a fair trial in the wards of his hospital, failed to “verify nearly all of Petresco’s conclusions, even to the small detail that the pulse fell, after one to three doses had been given.” He found the mortality increased by the Petresco method. “All the evil effects that can be produced by digitalis were noted, and after three days of the administration of the remedy such cumulative effects were produced as I hope never to see again.”

Carhart (11) believes that the use of digitalis in the first and second stages of the disease is one of the causes of the very large death rate. He believes that “it increases dyspnea, stimulates an already overstimulated heart, renders the pulse unsteady and intermittent, tends to produce heart paralysis, contracts the capillaries, and thus adds to the blood stasis in the lungs, with increased ventricular tension and all its subsequent train of evils.”

There is a safe middle ground for the therapeutist to stand and act upon.

“Toxemia is the most important prognostic feature of the disease” (Osler, 65). With this, consecutive depressed heart action, weakened and degenerating heart muscle, overworked or distended right heart, pro-

gressive lowering of blood pressure, associated circulatory obstruction, and vasomotor paralysis call for increased systolic force and vascular tone; hence for all that tends to stimulate and maintain heart action in the presence of these alarming conditions. "Therefore, digitalis should be given (a) from the beginning in every pneumonia where the heart muscle cannot be trusted, (b) should be begun at any point in the course of a pneumonia when any symptoms of a cardiac weakness are noted, or (c) even when there are manifest only abnormal claims upon the heart (abnormally full hard pulse, excited heart action, strong precordial pulsation, severe dyspnea), for it is better to anticipate cardiac weakness than it is to wait for its appearance" (Ortner, 64). It is questionable whether digitalis should be given in all cases with strong precordial pulsation and hard pulse. Associated conditions must be considered; if advanced arteriosclerosis and contracted kidney exist, it will be better during a limited period to use vasodilators, watching results and acting from hour to hour. If there is a decrease in cardiac conductivity, that is, partial heart block, digitalis should not be administered. If complete destruction of the His bundle, as is occasionally found in the pneumonia of the aged with advanced arteriosclerosis and chronic interstitial nephritis, then it may be given because the ventricles are no longer under auricular control, and digitalis increases ventricular strength, sending an increased volume of blood into the body. During periods of stress, when the right heart is overburdened, digitalis draws the blood in greater quantities to the extremities and through the lungs, because of the prolonged and stronger systole which it produces. It "refreshes the heart muscle" under some circumstances.

Hare (34) correctly says "that digitalis is less powerful in its effects in pneumonia than with valvular lesions, that with the infections associated with fever and myocardial degeneration it does not produce its full physiological effects." He believes that the cases of pneumonia which are most benefited by its use are those in which the circulatory failure is due to cardiac fatigue, and the heart is less poisoned by the infection.

The statement of Meara (55) is also correct, that when "arrhythmia or intermittences occur, although we know that in some instances the autopsy has shown a heart to be anatomically intact, I feel that we should not neglect the possible need, and should have little fear of the effects of unnecessary stimulation on a sound organ. *In such a case digitalis is indicated.*" With empty arteries and a struggling heart in pneumonia digitalis is positively indicated. Meara prefers eight gms. (3ii) of the infusion three to four times daily.

A reliable digitalis preparation causes increased tone of muscular tissue generally, most conspicuously in arterial and heart muscles, increases strength and duration of systole, and raises blood pressure. When indications are present for the use of digitalis there will be found a weak

systole, a small rapid, at times irregular and fluttering pulse, cardiac dilatation, weak second pulmonic sound, and other evidences of cardiac insufficiency, with obstruction in pulmonary circuit. With the first appearance of feeble or distant pulmonic second sound let digitalis be given.

With a failing heart and the indications for the administration of digitalis, and marked "vascular relaxation," *atropia* or *belladonna* administered with digitalis may assist in establishing vascular tone and may restore circulatory equilibrium (Hare). If the pulse continues "full" it is better to postpone the administration of digitalis; so long as the heart is doing its work satisfactorily, leave it to itself; let us attend to other pressing indications, more particularly the elimination of waste, the maintenance of the patient's strength, and *watch for the first sign of heart weakness*.

The average safe dose of *digitalis* is fifteen minims (1.0 gm.=grs. xv) of the fat-free tincture, ten minims (0.6 gm.=grs. x) of *digalen*. Any other preparation of digitalis may be given which contains its most important principle—digitoxin—in corresponding dosage.

No resinoid of digitalis possesses any properties which justify its use in the treatment of an acute condition in which we are fighting for life and in which prompt action is necessary. I refer particularly to digitalin.

Cases which come under observation in the second stage of the disease in which the right side of the heart is already engorged, the ventricles embarrassed by the excess of blood in their way, are best treated by *oft-repeated large doses of digitalis*, and in rare cases venesection and free catharsis. I have saved desperate cases by giving digitalis every half hour, watching the patient for the physiologic increase of systolic force with improved blood pressure and a slower pulse, when the interval between administrations was prolonged. In these desperate cases the poisonous effects of the contained digitoxin are needed; cases may occasionally be saved by this method which otherwise remain hopeless.

With a fatty and previously degenerated heart, with extreme plethora, digitalis is contraindicated.

Strychnin.—The results of toxemia with associated temperature on the nervous system may in a measure interfere with the action of digitalis in occasional cases; here the addition of *strychnin* simultaneously increases the effect of the drug.

If *strychnin* is given in pneumonia, it must be given in much larger doses than are usually recommended, if, acting as it does upon vaso-motor centers in the spine, it is to produce any effect upon these, already exhausted and robbed of their function.

At the present time the profession is skeptical concerning the efficacy of *strychnin* in the treatment of pneumonia. The feeling against its use is growing. Dock (16) does not consider strychnia indicated in the heart complications of pneumonia. "Strychnin is sometimes given, never necessary as a routine remedy, never indicated at a particular day

in all cases, and I cannot yet admit its usefulness in circulatory weakness" (Dock). On the other hand, the drug still has many adherents and very few cases of pneumonia are to-day treated in general practice, away from the larger medical centers, in which it is not given. Cohen (12) uses the arsenite of strychnin, given in small doses every hour ten times daily, believing that "the continuous discharge of nervous energy produced avoids violent and exhaustive discharges."

Adrenalin Chlorid.—*Adrenalin chlorid* is an exceedingly powerful drug in the treatment of the cardiac weakness of pneumonia. Pye-Smith and Beddard (76) make the statement that it is "in fact, by far the most powerful circulatory stimulant which we possess," to which Sajous (89) subscribes; he believes that the adrenals, thyroid and pancreatic secretions jointly supply the blood all its "immunizing constituents." The adrenal is in the ascendancy ("the amboceptor in the immunizing trio"). *It is best injected directly into the muscle or given with saline hypodermoclysis.* When blood pressure is low it often proves of value to bridge the patient over the critical period. *Edema of the lungs*, where the patient is drowning himself in his own serum, is best treated by other remedies, for it is likely to increase the edema in some of these cases. The development of glycosuria during its administration is not a direct contraindication to its use, for this is likely to happen. *The drug should be given only during limited periods*, because of the danger of necrosis of the liver. From ten to thirty drops of the 1 to 1,000 solution of adrenalin may be given every one, two, or three hours, according to the urgency of the symptoms.

[Adrenalin chlorid is the most valuable remedy we have in the vasomotor paralysis of pneumonia. The toxins of pneumonia act not only upon the vasomotor centers but upon the splanchnic nerve as well, paralyzing it and causing overfilling of the blood vessels supplied by it. As a result so much blood may be collected in the splanchnic area that general circulation becomes impossible. As soon as the evidences of splanchnic paralysis present themselves adrenalin should be given. It should be administered by hypodermoclysis in normal saline solution. As soon as the symptoms begin to disappear caffein sodio-benzoate is substituted for the adrenalin, which should be given by mouth as soon as possible.—Editor.]

Strophanthin.—Strophanthin is an amorphous or crystalline glucoside derived from the seed of the strophanthus plant. Fraenkel (31) first reported his experiences with the intravenous use of the drug in one-milligram doses. He holds that it is an active cardiac stimulant, most powerful in desperate cases of pneumonia, where prompt results are desired. The writer's experiences prove it to be *dangerous after digitalis has been used during several days, or in large doses.* The action of strophanthin is much like digitalis, the pulse is slowed and becomes stronger. If used in too large doses heart block may follow, the heart becomes irregular,

blood pressure falls, and death follows. It should be injected directly into the vein, being *careful not to introduce it into the surrounding tissues, for it is an irritant to connective tissue*. The median basilic vein should be selected. Both Stone (94) and Liebermeister (51) believe that its use enables a certain number of severe cases to be carried along until toxemia is eliminated, and to reach the road to recovery. Stone uses one milligram repeated in twenty-four hours. When the drug acts favorably blood pressure is raised, urine is markedly increased, the heart becomes stronger and resumes its work. Stone considers the free diuresis as being exceedingly favorable, for the "toxic products seem to him to be more rapidly eliminated than would otherwise be the case."

The writer has had a limited experience with strophanthin; too small to justify conclusions. He cannot speak encouragingly of his results. Sudden death has followed in two cases; both were extreme when the drug was used, both had been treated with digitalis.

Babcock (4) has seen sudden death from one-half milligram. Vickery (102) thought in one case he saved the patient's life; in some cases he found it a wonderful stimulant, and believes that "it is capable of giving the patient a short time longer of life, so that, if the crisis is almost due, he may get over the bar into the harbor."

Disastrous results will probably be reduced if standardized preparations are used. One milligram of Boehringer's strophanthin is so graduated that it is supposed to kill twenty frogs of given size. Strophanthin may be considered a stable preparation; Boehringer's strophanthin imported in ampullæ is reliable and standardized.

Camphor.—Camphor should be administered hypodermically in increasing doses as cardiac asthenia increases; it should be given as soon as digitalis is indicated, and may be given in twenty per cent. sterile camphor oil with a small addition of ether. This offers the best mixture for injection. It should be given in appreciable doses. When danger threatens, from .18 to .3 gm. (3 to 5 grs.) may be injected every one, two, or three hours. All recent writers argue in favor of this time-honored remedy (Leonard Weber, 105; Seibert, 91; Craig, 13; Hare, 34; Strümpell, 96; Meara, 57, etc.).

In hospital service and in private practice in desperate cases I have averaged as high as forty grains of camphor per diem during three to four days. Musk is often given with camphor and caffein.

Babcock (4) recommends the following mixture:

Musk, 1 gm.	gr. xv
Alcohol, 1 gm.	gr. xv
Sodium benzoate, .5	gr. viiss
Water, 15	℥iv
Filter; mix.	

A large amount of this filters very slowly because of the impurities in the Tonquin musk—(0.06 gm. ad 1 c. c.) (musk 1 gr. ad 15 grs.).

In young children camphor, 0.03 gm. ($\frac{1}{2}$ gr.), may be administered by the mouth with *benzoic acid* and sugar, where repeated hypodermic injections are objectionable.

Sparteïn Sulphate.—*Sparteïn sulphate* has been commended for its effect on the right heart, but the results have been disappointing, as a rule.

Diffusible Stimulants.—The secret of the rational treatment of cardiac asthenia must be found in such methods as restore or sustain heart strength and arterial tone during the period of stress. The *diffusible stimulants* sustain heart force during short periods only; unfortunately their effect is evanescent.

The writer's plan of treatment includes the administration of these at very short intervals during the continuance of cardiac asthenia. The stimulating effect must be continuous during the critical period. To get results the remedy must be repeated before the preceding dose has lost its effect; in other words, the fading effect of the preceding dose must be met by the strength of the following dose. In no other way can we accomplish the desired result in desperate cases.

I have administered every fifteen minutes, during periods of stress, fifteen drops each of the compound spirits of ether, aromatic spirits of ammonia, compound spirits of lavender, and tincture of valerian. This is kept up day and night until the pulse shows improved tone and the heart action is better, when the intervals are lengthened.

The valerian is added because of its quieting and tonic effect when administered in these small doses with the diffusible stimulants. Some critics without having used this treatment have feared stomach revolt; this rarely follows; when it does the compound spirits of ether has been temporarily omitted and whiskey has been substituted, or the dose of the ammonia and lavender was doubled. The frequent administration of the compound has not seemed to annoy the patients; they are not disturbed, but swallow automatically.

Alcoholic Stimulant.—Finally, the *alcoholic stimulant* upon which I depend with severe asthenia is Tokay wine. Only the genuine Hungarian wine should be used. This is administered in tablespoonful doses every half hour, and may be given with the ethereal stimulant when due. It has the decided advantage of containing an ethereal oil with a large alcohol content.

The remedies suggested are not antagonistic. *We are in the midst of great danger during a limited period, which justifies polypharmacy.* Experience proves that we have been successful in proportion to the faithfulness with which the treatment has been carried out.

Blood Pressure Study.—The treatment of the cardiac toxemia of pneumonia must include *blood pressure study*, which gives an unerring index to the treatment which should be carried out in the majority of cases (Hare, 34; McPhedren, 54; and Lambert, 48a). Hare insists that it gives "as much information as is obtained by the direct examination of the heart." It tells us something of the condition of the vessels and much of the heart muscle. Whenever possible, a full daily record of

the circulatory state should be kept. It will often lead to the early recognition of circulatory embarrassment. *A pressure much below normal in pneumonia is unfavorable; any great fall is ominous.*

"When the arterial pressure expressed in millimeters of mercury does not fall below the pulse rate expressed in beats per minute, the fact may be taken as an excellent augury; while the converse is equally true" (Gibson's rule). Active stimulation must be instituted whenever blood pressure falls to the pulse rate or below it.

There are cases of pneumonia complicated by arteriosclerosis and chronic nephritis in which blood pressure remains abnormally high during the first two or three days of the disease, in which the heart is laboring against peripheral arterial resistance. These cases tire the heart, already more or less degenerated, and demand vasodilators, preferably sodium nitrite or nitroglycerin. The arterial passages must be opened to relieve the overburdened heart. These cases offer a very serious prognosis, and in the majority, before the fifth day of the disease, the pulse, which was at first tense, slow, and bounding, becomes rapid, running, and erratic. An abnormally high blood pressure early in pneumonia with a comparatively slow pulse is serious. These cases, if associated with cardiac hypertrophy, stand alone in justifying the use of *veratrum viride*; this remedy, *aconite*, or the nitrites may be continued during limited periods only and under the strictest surveillance.

To raise blood pressure the treatment suggested for cardiac toxemia should be cautiously studied. *Digitalis*, *adrenalin*, *camphor*, and *caffein* will be most valuable. If *strychnia* is used at all it must be given in large doses; if alcohol, its effect must be studied, owing to the marked dilatation of peripheral vessels which follows its use. In occasional cases of pneumonia with arteriosclerosis, where the blood pressure is high and the myocardium tired without advanced degeneration, the latter may be rested and strengthened by the combination of *digitalis* and *nitroglycerin*. The dose of each depends on the relations of presenting conditions to each other.

VENESECTION

Sydenham (1624-1689) considered venesection his leading remedy for the treatment of pneumonia. Many authorities still approve of its use early, in robust, full-blooded patients, with a bounding pulse and high arterial tension. There are unquestionably cases of dilated and weakened right heart in which a timely venesection does yeoman service; these patients are, as a rule, plethoric, are likely to be alcoholics, flabby, and often abnormally fat, with surface venules chronically overfilled. If we could make clear the fact that the tension in the right heart is relieved so that its systole becomes more effective in dispelling its blood

into the pulmonary artery by means of venesection, we would rarely hesitate. This we cannot always promise; but we do occasionally accomplish the desired result.

It may not always be wise to abstract "one pint or a pint and a half," as S. West (106) recommends, but watching the patient and removing the quantity considered safe in well-selected cases, under conditions mentioned, is a rational maneuver. In all cases where the heart is laboring with an excess of blood the question of venesection must be considered and conclusions reached after a thorough consideration of associated symptoms. The leading indications are right-sided heart failure, with labored breathing, cyanosis, contracted pupils, distended surface veins, and profound toxemia. McPhedren says that the robust will bear almost any treatment, and will usually weather the storm. This has not always been my experience, particularly if toxemia is profound. The Gambrinus type of pneumonic is likely to show evidences of cardiac failure and pulmonary edema after the third day of the disease, though his pulse was full, slow, and tense early. He is a good subject for venesection, and cautious treatment of what surely follows, with or without blood abstraction, i. e., cardiac asthenia. McPhedren (54) is correct in his conclusion that patients with "ordinary vigor, or those even far from being robust, when they show the danger signals of a dilated or dilating heart," show some relief from venesection. It is unsafe to recommend bleeding in all these cases, however. It will be practical in but a few of these, but its indications ought to be considered oftener. The abstraction of from 200-400 c. c. of blood will suffice in the average case.

Rochester (81) quotes an English confrère in favor of venesection, who considers it scientific treatment because it helps "to make the blood clean and keeps it circulating." In the midst of a threatening pulmonary edema venesection should be considered, and local abstraction of blood by means of leeches is positively indicated. The use of hot fomentations when congestion is at its height, to promote bleeding after the use of six to eight *leeches*, is frequently practiced by the English and Germans, and often with relief of the overburdened heart and the pain. Kidd (45) believes that for the relief of pain there is nothing to compare with leeching. There can be no object in entering into the discussion of the *modus operandi* of bleeding, whether the improvement is due to the direct relief of the pulmonary circulation or the toxemia. Reduction of blood pressure in the pulmonary circuit, according to Reid (78), supplies the key to the treatment of pneumonia; he makes the statement that cases amenable to treatment "will recover if some means is adopted of reducing blood tension in the pulmonary circuit at that time in the course of the disease when the pressure is approaching its height, i. e., about the third or fourth day, and preceding the crisis." He believes that there is anatomical proof that bleeding in the intercostal space relieves tension in the

pulmonary circuit; abstraction from the intercostal spaces diminishes the flow from the azygos veins and thus diminishes tension in the pulmonary circuit. Reid's plan has been to apply two or at most three leeches over the consolidated area, allowing them to drop off in their own time and then keeping up warm fomentations for thirty-five minutes, following this with morphia.

TREATMENT OF COMPLICATIONS AND SEQUELÆ

Cough and Expectoration.—*Kermes mineral* or the *golden sulphuret of antimony* in fractional doses, averaging $1/32$ gr. (0.0019 gm.), is better borne than tartar emetic, because these are less depressing and less nauseating. They are particularly useful in the *later stages* of the disease, where the *cough is troublesome and expectoration scant*. In children the *anisated liquor ammonii* (Germ. Pharm.) in doses averaging from .12 to .3 (2 to 5 drops) may be given with a few drops of paregoric to relieve the cough and to promote expectoration.

When the expectoration is excessive during the period of convalescence, and the cough troublesome, the *compound tincture of benzoin* is a valuable remedy. This may be given in 1.2-gm. doses (20 drops) on sugar with a little water three or four times daily. With a dry, hacking cough, paroxysmal in character, and more or less laryngeal and tracheal irritation, *ammonium chlorid* with *codeia* relieves these annoying symptoms in the majority of cases.

Tincture sanguinaria may be given with cherry laurel water during the period of convalescence to relieve cough, which is due to laryngeal and tracheal engorgement, which occasionally follows the acute periods of the disease.

Crisis.—The treatment of the patient during crisis demands, besides close watching, absolute rest, quiet, repeated reassurance, heat to the extremities, stimulation in accordance with the indications offered by the circulation and reduced temperature, the occasional administration of ethereal stimulants, adrenalin, atropia, strychnia, caffeine, opium, musk, and camphor, according to the symptoms present in the individual case. The dangers of crisis have been exaggerated; attention to detail without much medicine, and proper diet, with a bracing cup of coffee at short intervals, added to the strong personality of the nurse and physician, will be sufficient to carry the majority of patients to convalescence.

Delayed Resolution.—*As a rule so-called "delayed resolution" is due to some discoverable complication.* However, occasionally this condition is present and demands treatment. The general health and nutrition of these patients require direction. Climatic treatment should be considered. Deep breathing should be practiced and encouraged under the personal supervision of the physician. Externally the compound soap poult-

tice and iodine may be used. Calcium, ammonium, or sodium iodide often prove useful. Edsall and Pemberton (18) report successes from the application of X-rays. The cases treated by these investigators were promptly influenced by the remedy, the consolidated areas clearing with, at the same time, a marked increase in the metabolic output through the urine; thus the features of normally resolving pneumonia were reproduced. Fibrolysin (Merck, 58) has been recommended in these cases. *No case should be considered to be one of "delayed resolution" or "unresolved pneumonia" until a thorough process of differentiation has made the diagnosis positive.* Tuberculosis or empyema will be found in the majority of cases.

Bilious Pneumonia.—The so-called bilious pneumonia may be treated much like the typical disease—giving attention to the greater and earlier cardiac asthenia and to the organs of secretion and excretion. Free diuresis, abundant water, salines, and catharsis with salicylates deserve consideration. The use of rectal salines and hypodermoclysis in these cases have occasionally helped to bridge the patient over the critical period.

Pneumonia of the Alcoholic.—In this article we have frequently referred to indications offered by the alcoholic sick with pneumonia. In the treatment of this condition, which is, as a rule, fatal to these subjects, we would refer the reader to suggestions already made. It may be positively stated that alcoholics demand alcohol; without it they collapse. A sufficient quantity is demanded to assist in the nourishment of the patient, and to keep up the pulse. Nervous excitability must be allayed; the patient must be protected against himself by proper nursing and medication. Hyoscin, morphia, chloral, paraldehyde, and ethereal stimulants are included in the remedies, from which selection may be made. The choice of the remedy for the individual case demands considerable thought and modification, in accordance with changing conditions. The alcoholic should receive the needed supply of liquid, his thirst must be allayed. The heart gains strength while the alcoholic sleeps. His wild delirium wears him out. In the majority of the severe cases there is "wet brain," i. e., alcoholic meningitis which often antedates the pneumonia.

Afebrile Pneumonia.—There are cases of afebrile pneumonia which pass to crisis or lysis with positive physical signs. These are not infrequently of grippal origin. They are most frequently found among the aged, with arteriosclerosis or renal complications. There is great danger in these cases of sudden cardiac asthenia and overpowering toxemia. The diagnosis may be missed; once made, the cases demand thorough watching. The indications for treatment are offered by the heart and pulse, while all processes of elimination must be guarded.

Pneumonia of Diabetics.—The pneumonia of diabetics offers an ex-

ceedingly grave prognosis. In these cases the general tonic plan of treatment suggested in this article should be followed, and alkaline waters liberally administered. Occasionally this treatment is rewarded with success. The majority of these cases are atypical and present complications demanding special attention.

Pulmonary Edema.—There is an unfortunate class of cases with early heart weakness and pulmonary edema, in which the lung is promptly flooded. These patients really drown themselves in their own transudate and often die during the first thirty-six hours of the disease, in spite of any known treatment. When face to face with such threatening conditions, the free use of cups and venesection are positively indicated, more particularly if the patient is plethoric. To these may be added mustard foot baths, while the hypodermic use of atropia and morphia with other cardiac stimulants hypodermically administered may occasionally lead to improvement. These methods are simply time-saving in their effects; they may make it possible to bridge the patient over a critical period; for, the toxemia being short-lived, we may on rare occasions find ourselves transported to a clearer and more favorable atmosphere.

Meningitis.—Meningitis is a more frequent complication of pneumonia than has been recognized in the past. Lumbar puncture with examination of the fluid withdrawn has established this fact. Kleinschmidt (46) and Liebermeister (51) have demonstrated the fact that suppurative pneumonic meningitis is found post mortem without symptoms of the disease during life. The profound delirium of pneumonia is a frequent evidence of existing meningitis, and treatment should be framed accordingly. In all of these cases lumbar puncture is justified, with the internal administration of hexamethylenamin and the pneumococcus serum.

Acute Dilatation of the Stomach.—Acute dilatation of the stomach is an occasional serious complication of pneumonia; it is a source of great danger. When it arises suddenly during the height of the disease it may promptly lead to death. Sudden dilatation with chronic valvular lesions and pneumonia is usually fatal. Fussell (32) has recently reported his experiences with this dangerous complication. In all of his cases the autopsy showed constriction of the duodenum at the root of the mesentery. There is in all probability involvement of the innervation leading to dilatation, this in itself causing by traction a constriction of the duodenum. These cases, which are easily recognized because of the associated physical signs, including peristaltic unrest, splashing, and collapse, demand immediate washing out of the stomach, which should be repeated according to the urgency of the symptoms. The tube may be used, though the patient is found in collapse. The patient may be turned on his side to encourage the emptying of the stomach; this maneuver without lavage is of but little value. Strychnia and eserine salicy-

late have been recommended, but are of doubtful value. The tube alone gives results. Meltzer suggests that the dyspnea with frequent swallowing of air without saliva may be a factor in the production of the dilatation.

Cases in which accumulation of gas is troublesome, without excessive dilatation of the stomach, are often relieved by the administration of a few drops of chloric ether on sugar with 1 gm. (15 drops) of compound tincture of cardamom. The Germans use compound spirits of ether dropped on sugar at short intervals for the relief of this symptom.

Hiccough.—A frequent complication of pneumonia, usually at the height of the disease, sometimes following the febrile period, is *hiccough*. There are cases in which this symptom is exceedingly rebellious to treatment. At times ten drops each of *Hoffman's anodyne* and *compound tincture of cardamom* on sugar, slowly swallowed, suffice to relieve. Hypodermic injections of morphia often cause a restful sleep during which the spasm ceases, and on awakening hiccough has disappeared. In many cases, however, there is prompt recurrence with great prostration, agitation, and excessive nervousness. Under these desperate conditions, when patient and physician were discouraged, musk, .06 gm. (1 gr.) in capsule every two or three hours, and an occasional morphin injection, have helped. With sustained improvement the hypodermics may be discontinued, but the musk should be continued for several days. Finally strontium bromid, 1-1.5 gms. (15 grs. to 23 grs.), may be given, well diluted, to produce sleep, after discontinuing the morphin injections.

Bradycardia.—Bradycardia often follows pneumonia whether treated by digitalis or without. At times this is accompanied with intermission, arrhythmia, and occasionally extrasystoles. With bradycardia the pulse may be intermittent; this need not worry the attendant if there are no associated symptoms, and the general condition improves from day to day. The ungeared state of the heart may persist during several weeks, yielding to rest, and the usual tonic treatment given convalescents.

Tachycardia.—In some cases tachycardia becomes annoying during the period of convalescence or after pneumonia. Endocarditis may have been present in these cases; it should be suspected, as should other complications, including tuberculosis, phlebitis, hidden abscess, empyema, etc. The therapist will not be long deceived, for thorough consideration of associated conditions and physical examination will reveal the cause of the rapid heart. Without other complications recovery from these cardiac anomalies of a purely functional character follows in the course of time. Complicating endocarditis has in a number of cases promptly yielded in the presence of malignant symptoms to polyvalent pneumococcus vaccine (Henry, 38).

Endocarditis.—Acute endocarditis, which complicates nearly ten per cent. of lobar pneumonias, yields in the majority of cases to the treat-

ment which controls the general infection. All cases should receive absolute rest and cold locally. In painful and severe cases counterirritation over the precordium is justified, if cold fails to relieve. This complication materially affects prognosis and retards convalescence.

Pericarditis.—When pericarditis is added, or when present without endocardial invasion, indications for treatment remain much the same. Purulent and large serous effusions into the pericardium demand surgical interference without delay.

Bronchorrhea.—Bronchorrhea following pneumonia with irritating cough is an occasional complication during the period of convalescence and following. It is usually relieved by terebene, .6 gm. (10 drops), given in capsule three times daily with .6 gm. (10 drops) of fluid extract of chekan. Compound tincture of benzoin is also a valuable remedy for the same purpose.

Pleurisy with Effusion.—Pleurisy complicating pneumonia is present in most cases, and is relieved by the remedies suggested for the relief of pain under General Management. It is rare that the accumulation of fluid resulting from pleurisy in uncomplicated lobar pneumonia demands special treatment.

Empyema.—During the period of convalescence empyema becomes a frequent complication, which can only be rationally treated by prompt and free drainage. In children and adults these cases offer a splendid prognosis if the complication is recognized early, and radical treatment is immediately instituted. Aspiration of these cases is a makeshift which robs the patient of strength and unjustly postpones what is finally demanded—the free opening of the pleural cavity.

Gangrene of the Lung.—Gangrene of the lung is usually fatal, and a complication which vitiates the atmosphere surrounding the pneumonic. The patient may be made more comfortable and bearable by the internal administration of terebene and by the inhalation of balsamics. Eucalyptol, oil of sylvestrian pine, compound tincture of benzoin are particularly useful for this purpose. A combination of equal parts of the three preceding drugs with one part of tincture of opium, one teaspoonful of the combination may be used with a steam atomizer for inhalation three or four times daily. It will prove comforting to the patient and to those who are forced to remain in the sick room.

Abscess of the Lung.—Abscess of the lung following pneumonia demands surgical interference if within the reach of safety. It is a surgical complication often recognized only after its rupture.

Nephritis and Pneumonia.—Chronic nephritis, either tubal or interstitial, complicated with pneumonia, presents conditions of extreme gravity, the treatment of which has been considered in connection with that of cardiac toxemia, blood pressure study, and other associated features. Each case will demand special attention, but the general con-

siderations presented in this article give sufficient hints to guide the therapist.

Convalescence.—A thorough appreciation of the effect of malign infection will be sufficient to direct the treatment of the period of convalescence along rational lines. The depressing effect on the heart muscle of the pneumonic demands a sufficient period of rest. Too many are permanently damaged because the cardiovascular system is denied the repose which is an absolute necessity after all grave infections, particularly pneumonia, typhoid, and diphtheria. Too often the attendant allows himself to be swayed by sentiment and yields to the importunities of the patient, anxious to return to his work, little appreciating the possibility of inviting permanent damage. It is unwise to set a time limit during which the patient must remain quiet and under observation; let the study of the case lead to a safe decision. Pulse, blood pressure, the general condition of the patient, including the blood state, will aid in deciding on the time when it will be safe to venture beyond the supervision of the physician. Rest, massage, a well-selected diet, deep breathing, attention to ventilation, stimulation of the appetite where necessary by bitter tonics, the addition of an extra supply of carbohydrates, cod liver oil where indicated, iron in easily digestible form, arsenic, the hypophosphites, malt, and lactate of lime include what is needed in the majority of cases. In some cases climatic treatment is indicated. The selection of the proper environment for the convalescent who needs a change demands the thorough consideration of many factors, and becomes an exceedingly important and responsible matter.

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CHAPTER XIV

DIPHTHERIA

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Diphtheria is an acute infectious disease caused by the Klebs-Loeffler bacillus. This bacillus can grow upon any mucous membrane, and upon the skin itself when the epidermis has been removed. Occasionally it is found in the blood.

At the site of their growth these bacilli generate a toxin which is absorbed by the lymphatics, carried by these to the general circulation, and then by the blood to all parts of the body.

The constitutional symptoms of the disease are caused by this toxin. A brief review of its action is necessary to thoroughly understand the treatment and certain complications which arise.

At the site of infection the diphtheria toxin causes the formation of a false membrane. This membrane is at first firmly attached to the sub-mucous connective tissues, but later undergoes coagulation necrosis. This degeneration is typical of the whole pathology of the disease, for when the toxin gets into the general circulation it is carried to all parts of the body and exerts its baneful influence on the cells of almost all the important organs of the body. This is shown chiefly by the symptoms which arise from its action on the heart muscle, the central nervous system, the kidneys, and the lymph glands. Diphtheria is, then, a true toxemia, and our treatment is based principally upon the idea of neutralizing this toxin, and also of using such additional remedies as may keep the patient from succumbing to heart failure and assist nature to repair the damaged organs.

PROPHYLAXIS

Enlarged tonsils and adenoids predispose to inflammatory diseases of the throat. Children having such ailments should be treated. If necessary the tonsils and adenoids should be removed. During epidemics much caution must be exercised in removing such tonsils and adenoids, for their removal leaves a large raw surface, extremely susceptible to infection; and, should diphtheria develop, a severe case results. Children of diminished resistance and vitality should be built up by proper diet and

hygienic living, assisted by the usual remedies to produce tonic effects. Inasmuch as adenoids and lowered resistance are conditions that are not always noticed or understood by people, medical school inspection should be established in all communities and the attention of parents called to physical defects.

All cases of diphtheria should be quarantined. In this disease much can be accomplished by this and by other measures for preventing its spread.

Quarantine may be at home, but should preferably be in a hospital. It should include all persons in whom the bacilli are present. If the patient is kept at home a floor should be set apart or a room selected for the patient that can be cut off from others, preferably a room in the top of the house with an open fireplace. A fireplace is of advantage not only for warmth when needed, but for ventilation, and for burning waste cloths that have been used by the patient. The room should be well ventilated and should have exposure to the sunlight, for fresh air and sunlight are important aids in treatment. The temperature should be kept as near equable as possible.

Quarantine in a hospital is more effective. For this reason, and as many cannot be otherwise quarantined, hospitals for infectious disease with pavilions or wards for diphtheria should be erected in every built-up community, to which patients can be removed from hotels and boarding houses. In connection with such a hospital there should be a steam disinfecting plant where mattresses, blankets, etc., can be made safe for further use.

All rugs, carpets, and draperies and unnecessary articles should be removed from the sick room. All animal pets should be excluded. Dogs can carry diphtheria. No food should be allowed to stand in the room. No visitors should be allowed; only those persons charged with the care of the patient should be admitted. Toys and playthings used by the sick child, unless they can be thoroughly disinfected, should be burned at the termination of the case.

It is well to use wooden spatulas rather than a spoon in looking at the throat. It is also well to use cloths for expectorations. These should be burned immediately after use. If this cannot be done at the time they should be placed in a five per cent. solution of carbolic acid until it can be done. All vessels should be sterilized by boiling.

The physician and nurse should each wear a gown which is not to be taken from the room. They should be careful not to let the child cough in their faces. Hands should be disinfected with five per cent. carbolic or a bichlorid solution. The patient's clothing, bed clothing, towels, etc., should be disinfected by placing them in a five per cent. carbolic solution before turning them over to others for washing. They should be boiled. It is well to keep a sheet moistened with a carbolic solution at

the door of the room. This does not disinfect the room, but adds somewhat to the care of the entrance, probably catches some dust, and helps to avoid outward draughts.

If the disease is epidemic in school it is well to close the school. In case of death the funeral should be private.

IMMUNIZATION

When a case develops and the diagnosis has been made all other members of the family should receive at the earliest possible moment an immunizing dose of diphtheria antitoxin. Immunization is especially indicated in hospitals, asylums, and institutions for children. It is often wise to immunize children who attend public schools when an epidemic exists in the neighborhood.

In immunizing the members of a family in which a case exists there is frequently seen what is called a cold. The child has a seemingly simple rhinitis. This often proves to be diphtheria. A culture should be taken, and the case watched until the result of the culture is known. The immunizing dose of antitoxin should be large enough to cure such a case. For all persons over one year of age the dose should never be less than 1,000 units, and where the exposure has lasted five or six days it should be 1,500 units. Infants under one year and over six months should receive 500 to 1,000 units, depending on the duration of their exposure. The dose for those under six months can be graduated downward according to their age, and for those only a few days old the dose should be about 100 units.

These doses can be given with an ordinary hypodermic syringe. The pain from the injection is slight and the after pain is no more severe after a large dose than after a small one. Constitutional symptoms need not be considered, as a rule, for at most with the present antitoxin they only amount to a transient rash, usually urticarial or erythema multiforme in character, with a slight rise in temperature. We have seen only one case in which serious symptoms followed its use in more than 15,000 cases treated.

The advantages of immunization are best shown by the record of the New York City Health Department, which shows that of over 80,000 cases immunized only 182, or 0.2 per cent., developed diphtheria, and of these 182 but one died.

TREATMENT

Diphtheria for clinical purposes can be divided into two classes:

- a. Cases in which the infection is above the larynx.
- b. Cases in which the larynx or trachea, or both, are involved; the so-called croup cases.

As far as internal treatment is concerned it is the same in both classes, but their local treatment is quite different.

Antitoxin Treatment.—All cases in which diphtheria is suspected should receive at once a dose of antitoxin. Physicians are frequently called to a case where the diagnosis is not clear at the time of the first visit. Whether the case is a beginning diphtheria, tonsillitis, syphilis, or Vincent's angina cannot always be determined at the first visit, and to await the result of culture means a delay of from 24 to 48 hours. Antitoxin will not hurt any of these cases, and the early use of it will not only shorten the duration of the sickness if it is diphtheria, but it will lessen to a very large extent the probability of serious complications developing later. The same is true of croup cases. Whenever the attack does not subside in two to four hours antitoxin should be given. An early dose will obviate the necessity of intubation and protect the child from the dangers of such treatment. This point cannot be impressed too forcibly. I have many times been called to intubate where the physician had considered the case a simple laryngitis or bronchopneumonia, and had not suspected diphtheria because he could not see any false membrane. The amount of antitoxin given to these cases should never be less than 5,000 units.

In cases where the diagnosis is clear what guides are there for regulating the amount of antitoxin? What symptoms or group of symptoms indicate that this case should have so many units of antitoxin and that one so many? There is no absolutely positive indication to show the exact dose necessary in any case. No one can estimate absolutely the amount of toxins that have been and are being absorbed. The principal thing to do, therefore, is to be sure to give enough antitoxin. We can be guided to some extent by the amount of false membrane present, its location, the duration of the disease prior to diagnosis, and the general constitutional symptoms, such as prostration, condition of the heart, the pulse rate, and mental apathy.

The location of the membrane is very important. There are two places where its presence indicates large doses of antitoxin. First, the nasopharynx. Absorption from this region is very rapid and very great, consequently these cases show early and severe prostration. Second, the larynx or trachea. Here it is necessary to hasten as much as possible the disappearance of the false membrane for mechanical reasons—i. e., to open up the occluded air passage. The extent of the false membrane and the duration of the disease are also important guides in determining the size of the dose.

To summarize: All cases over one year of age which have been ill 24 to 36 hours and show membrane limited to the tonsils should receive at least 5,000 units; infants under one year 3,000 units.

Cases over one year with membrane extending to the soft palate and

uvula, or to the posterior wall of the pharynx, should receive 10,000 units as an initial dose. Cases similar to these with the additional involvement of the nose or nasopharynx should receive an initial dose of at least 12,000 units to 15,000 units. Septic cases, which have been ill five to seven days with necrotic membrane of extremely foul odor, with tendency to hemorrhage from the nose or pharynx, and petechial spots in the skin, can be given enormous doses, up to 20,000 units. Even larger doses have been administered.

All croup cases should receive at least 10,000 units, and if the pharynx is involved with the larynx the dose should be increased to 15,000 units.

It is frequently necessary to repeat the dose. The indications for this are: 1. If, after 24 hours, the false membrane is spreading, or does not show signs of curling at the edges. 2. If the general symptoms are not improved, as shown by the pulse rate being either the same or increased, the pulse itself being softer and more compressible. 3. The mental apathy being the same or more marked.

This latter is an extremely valuable guide. In cases where sufficient antitoxin has been given its improvement is more rapid than that of any other symptom. In croup cases, unless the obstruction is less, as shown by the cough being looser, less metallic, and more moist, and the dyspnea less, the dose should be repeated. In all cases the second dose should be as large as the first. The indications for the third and fourth doses are the same as for the second, but the interval between the second and third and between the third and fourth can be reduced to 12 hours. When a maximum of 40,000 to 50,000 units has been reached it is useless to administer more. Further injections only increase the suffering of the patient.

SITE AND MODE OF INJECTION.—It is hardly necessary to say that the injection should be done only with the strictest aseptic precautions. In choosing the site for the injection we must take into consideration two factors: 1. The injection should be made where there is sufficient loose areolar tissue to reduce the tension to a minimum. 2. To interfere as little as possible with the patient's obtaining a comfortable position in bed.

One region which best meets these indications is the midaxillary line at or about the level of the nipple line. Injections in the arm, leg, or buttocks are apt to cause the patient unnecessary suffering, except in immunizing doses. Another point is that the injection should be well under the skin, and not into it. After the injection a wet alcohol dressing should be applied. This can be done by saturating a piece of absorbent cotton the size of an egg and fastening it on with a strip of adhesive plaster. This should be continued for 24 to 36 hours. It relieves the pain following the injection and decreases the possibility of abscess formation.

With the present antitoxin, rashes of a mild character, usually urticarial or erythema multiforme in type, occur in about 30 per cent. of all cases injected. They are never severe. A mild cathartic or calomel in small repeated doses followed by a saline may be given, and if much itching is present a lotion applied.

ANAPHYLAXIS AND ANTITOXIN.—This phenomenon sometimes occurs. The symptoms at times are severe and death may result. Injections repeated at short intervals as described above never cause serious symptoms, but if an interval of ten days or more occurs between the injections serious results may follow. I remember one case of measles which had been exposed to diphtheria. After receiving an immunizing dose of antitoxin diphtheria developed about two weeks later. A larger dose was then administered, and four days after this the child, a boy of about five years, developed an extensive rash, hemorrhagic in character, temperature, 105, diarrhea, diffuse bronchitis, rapid prostration, and death succeeded. The symptoms, as a rule, however, are not very severe, and the possibility of anaphylaxis should not prevent us from using diphtheria antitoxin where an immunized person develops diphtheria.

Local Treatment.—As a rule, after a sufficiently large dose of antitoxin has been given, the false membrane disappears in the course of a few days. In cases where it is limited to the tonsils it is entirely gone in about 48 hours. Where the membrane is more extensive a day or two more may be necessary. This happens without the use of local treatment. Such local treatment does not hasten the result. So that in many cases it is unnecessary to use any other treatment than antitoxin.

It is, however, sometimes necessary, for other reasons, to cleanse the patient's throat and nasopharynx and nose of disintegrating membrane and mucus, relieve the painful throat and the obstruction to breathing.

To be of real value it should be used sufficiently often to accomplish this and not tire the patient, and the solution should not be of a character to cause any harm if swallowed. The remedy which best meets these indications is normal salt solution at a temperature of 110° F. In ordinary cases it can be employed every four hours, and where there is very much mucus present it can be used every two hours for the first twelve hours. It should be discontinued when the pharynx is clear of membrane. With a child the proper method is as follows: The child is laid on a sheet, which only comes up to the insertion of the deltoid muscles, with the arms extended by the sides; the sheet is then wrapped tightly around its body and fastened with safety pins, one at the top, one at the hips, one at the knees, and one at the feet. With this dressing properly applied the patient is helpless, but there is no interference with the respiration as there would be if the sheet were brought up around the neck. A rubber sheet is then pinned around the neck, and the child is laid on a table with its head on a small rubber pillow or in a Kelly pad. The

warm saline solution, of which a quart should be used for each irrigation, is poured into a fountain syringe which is suspended not more than two feet above the patient's head.

When the nose is involved as well as the pharynx the former should be irrigated first. For this an olive-shaped tip with a central opening is employed, allowing the solution to enter one nostril and run out the other. The flow can be regulated by the nurse so that no force is used, and where there is much obstruction it should be discontinued. Forcible irrigation with a syringe to expel large pieces of membrane should never be employed.

For irrigation of the throat a large nozzle about six inches long and one half inch in diameter, with a central opening, is the best. This is introduced between the cheek and the teeth, and if the child tries to keep the mouth closed some of the solution is allowed to run into the mouth, this will at once cause the mouth to open, when the end of the nozzle can be placed between the teeth. The solution is then allowed to run a little at a time, the flow being regulated by the nurse. After a few irrigations the patient becomes accustomed to the treatment and does not resist it.

The above is by far the best local treatment, and can be carried out in nearly all cases. It should not be used, however, when there is severe prostration with a weak heart.

Cases where the larynx is involved should never be irrigated, as the coughing caused by it might bring on a spasm of the glottis, which would necessitate intubation or tracheotomy.

Sprays may be used, but they are much inferior to irrigation. When they are used they should be mild and non-irritating, as, for instance, Dobell's Solution. Strong antiseptics are not advisable. They irritate the throat, and the danger from swallowing them is considerable.

There are many cases whose mouths show positive cultures, but who have no other symptoms of the disease. In such cases mouth disinfection should be practiced. Ordinary antiseptic mixtures for rinsing the mouth are increased in their efficiency by the addition of alcohol.

To assist in throat disinfection:

Not only in these cases, but also in those who show symptoms of toxemia I have used with apparent success a mixture such as the following:

R Hydrarg. chlor. corros.	gr. i	0.065
Acid. muriat. dil.		
Tr. ferri chlor.	āā 3vi	24.008
Aquæ q. s. ad.	3iv	150.002

M.—Sig. 3i (4 c. c.) in a cup of water every four hours, taken slowly through a tube.

Intubation.—In cases where the larynx is involved irrigation or other local treatment to the larynx should never be used. Intubation should be delayed as long as it can be with safety.

The indications for intubation are aphonia, dyspnea, cyanosis, retraction of the supra- and infrasternal regions, associated with a progressively developing croup. The child is sleepless, restless, and seems to actually reach out for air; at the same time the pulse becomes rapid and the heart weaker. In cases where the larynx or larynx and trachea are involved only this weakness is due very largely to fatigue from the physical efforts of breathing. Since the absorption from these parts is not so large as from the pharynx and nasopharynx the action of the diphtheria toxin on the heart is not very great. When these parts are involved together with the larynx we then have a double action on the heart. There are, however, two indications to be met in these cases:

1. Relieve the dyspnea.
2. Relieve the strain on the heart.

In some cases it needs only a glance to show that intubation must be done at once. In others it is extremely difficult to decide. It is almost impossible to give any fixed rules for guidance. The heart should always be watched, and if it shows signs of failure intubation should not be delayed.

A mistake is frequently made in cases with extensive involvement of pharynx and nasopharynx. Here the obstruction is entirely above the epiglottis and, of course, intubation is not only *not* indicated, but adds to the gravity of the case. A valuable point in diagnosis is the presence of the voice.

Another point to be taken into consideration where intubation is delayed is the time which must elapse before a revisit. This applies especially to patents in the country. All patients with a severe croup, who are not intubated, should be seen six and twelve hours after injection of antitoxin, and the parents told of the danger signs. Poulticing with hot flaxseed meal or the use of hot cloths will relieve the dyspnea sometimes for an hour. The poultice should extend from the ramus of the lower jaw to the middle of the sternum, and at least halfway around the neck. To be of any value it should be kept hot. A cold, soggy mass around the neck does absolutely no good and is extremely disagreeable.

The regular intubation set consists of seven tubes graduated according to the age of the patient from one year to twelve. Special tubes for six and nine-months-old infants can be obtained.

The operation of intubation should never be attempted until the physician has had considerable practice on the cadaver, and has trained his finger to recognize the landmarks in the throat. The larynx and trachea of a young child are very delicate organs, and serious damage can be done very easily. The operator should always remember this, and above all things never use any force.

The best intubation tubes are made of hard rubber with a metal lining, after the original O'Dwyer models. All so-called improvements have

only detracted from their value. Metal tubes become rough from the action of the secretions of the larynx.

When intubation is to be made the child is laid on its back with one assistant holding the gag and another holding the feet with one hand, and with the other hand preventing the child from squirming and twisting around. With the gag in place the assistant holding it extends the head so as to bring the larynx and trachea into the same plane, the operator then introduces the index finger of the left hand into the patient's pharynx until it reaches the arytenoid cartilages. He then raises the epiglottis and pulls it well forward out of the way. Frequently the epiglottis will be found curled downward in the larynx, and it should always be straightened out before any attempt is made to insert the tube. In pulling the epiglottis forward the base of the tongue should be pulled forward as well. This helps to steady the larynx and hold the epiglottis out of the way. This is the most important thing in the operation. After this is done the tube is introduced into the mouth, the operator using the finger holding the epiglottis as a guide, and always working in the middle line of the mouth. When the end of the tube enters the larynx the right hand, holding the introducer, is raised until it brings the tube parallel to larynx and trachea. This is done when the introducer is at a right angle to the neck. At this point some resistance is usually met with, caused by a spasm of the muscles of the larynx. To use any force now may cause serious damage, even to the rupturing of the larynx or making a false passage through one of the ventricles. To overcome this spasm the tube is simply held still for a few seconds, when the muscles relax and the tube can be gently pushed into position. When about halfway in the tube is pushed off the obturator and the rest of the insertion is done by the finger which held the epiglottis.

To introduce the tube with the child in an upright position the child should be held upon the nurse's lap, leaning against her, the nurse's arms about the child. A gag is placed in the left side of the mouth and the operator sits in front.

In extubating the same position is employed, and the same necessity exists for getting the epiglottis out of the way. The posterior wall, or the upper end of the lumen of the tube, is beveled, and unless the blades of the extractor are introduced well into the tube they will slip. To accomplish this it is necessary to bring the handle of the extractor to a right angle with the neck. Be sure the blades are in the tube before opening. If they are between the tube and the wall of the larynx opening and withdrawing them will cause serious lacerations of the part. The same necessity for using no force exists here as in intubation. The dangers are laceration of the larynx and pushing the tube through the cricoid opening into the trachea.

Extubation should be done as soon as the child can get along without

the tube, as a rule on the fourth day after intubation. In some cases where there is much membrane in the pharynx, or where a piece of thick membrane has been coughed up at the time of intubation, the tube may be left in one or two days longer.

Reintubation is frequently necessary, and the child should not be left after extubation as long as the cough is tight and metallic and any dyspnea exists. Extubation should always be done when the stomach is empty to prevent the vomited food from getting into the larynx. Bromids or morphia may be given an hour or two before.

Medicinal Treatment, Diet, and Nursing.—Remembering the pathological action of the diphtheria toxin, treatment endeavors to aid nature to counteract these changes. In addition to the use of antitoxin there are certain indications to meet. Strengthen the heart, relieve the strain on the kidneys, and when the disease has terminated build up the patient.

To relieve the strain on the heart muscle the patient should be kept in bed and not allowed to do anything which may cause muscular exertion. When it is necessary to move the patient he must be carried. A bed pan should always be used, and the patient not allowed to sit up on a commode. Careful nursing can do a great deal of good, and the least neglect may result seriously.

The diet should be milk alone until the throat is clear of membrane and the pulse rate below 100 beats per minute. At this time, if the urine contains no albumin, the amount of food can be gradually increased, adding first milk toast, a soft egg, thin soups, or beef juice. But the urine must be watched carefully for the next ten days, and, as a rule, when albumin is found, everything except milk must be discontinued.

During convalescence iron and general tonics are called for. A useful preparation is the elix. of iron, quinin and strychnin.

The patient's family will be anxious to know how long the patient must remain in bed. This, of course, depends on the gravity of the case, but the mildest cases should be kept in bed for at least ten days and then, if the pulse is regular and normal in rate, the urine shows no albumin, and the heart's first sound is muscular in quality and not sharp and metallic, the patient may be allowed in a chair for a short time. The time may be gradually lengthened if the heart stands the strain. Severer cases should remain in bed for three weeks and not be allowed to get up until their physical condition, as shown by the pulse-rate and quality and condition of the heart, warrants it. Sudden death from acute heart failure can only be guarded against by keeping the patient quiet for a long time. With the pulse rate of a child over 100 it is extremely dangerous to allow it out of bed.

Pure croup cases, as stated before, do not show the same toxemia as do those where the pharynx is involved, but they should receive the same treatment with smaller doses.

Feeding of intubated cases must be specially considered. Nursing babies should be kept on the breast. Older children soon learn to swallow without much trouble, but they should be fed very slowly at first. Semi-solids such as plain, pure ice cream can be given to them. The Castlebury method, holding the child in the nurse's lap with the head lower than the shoulders so that the fluid runs down over the hard palate, may be necessary at times, but in our personal experience has proven of little value. With infants a good plan is to use a minim graduate and feed through the angle of the mouth. Feeding by gavage with a small rubber catheter through the nose is very seldom needed, and should only be used as a last resort, as it causes the nose and mouth to become foul and frequently septic.

Myocarditis.—The chief complication of diphtheria is myocarditis. It occurs in practically every case, but is most marked in cases with pharyngeal involvement, and is least in croup cases.

The treatment of this complication is prophylactic. The earlier antitoxin is given the less danger we have to fear from heart failure. The larger the initial dose of antitoxin the less danger also. The treatment of the complication itself is absolute rest in bed, no movements of the body of any sort being allowed, and if the pulse is poor in quality and rapid, the first sound of the heart sharp and valvular in character, all local treatment should be discontinued. The food must be given in small quantities frequently repeated. An ice-bag over the precordial region is frequently of service. Inhalations of oxygen may be used, but I have not seen any marked results follow its use. Stimulants must be used.

The Question of Alcohol.—With many physicians, and with a large number of the laity, there has been a strong presumption in favor of the value of alcohol and its use in disease. This has rested more upon clinical observation than upon scientific fact.

My personal experience is that in many cases it is not only of doubtful value, but a detriment to the patient, especially when the patient takes it for the first time, and in cases which are complicated with albuminuria. For this reason for many years I have not used it extensively in my practice. And this view has of recent years been upheld by scientific studies in immunity and lessened resistance by the use of alcohol. In diphtheria part of the reputation that it has held may have been due to its local effect, for without doubt it is a useful mouth disinfectant. But taken either as a food or as a stimulant I believe it is of very doubtful value and may do great harm to the kidneys.

As opposed to this view practically all authorities recommend its use in diphtheria—many liberally—and Dr. Binford Throne, who has collaborated with me in writing this article, says: "All cases of diphtheria have more or less myocarditis and all should be given stimulants from the first. The best is good whisky or

brandy. A child of one to two years may be given a drachm (4 c. c.) every four hours, and older children up to 3ii (8 c. c.) every two hours." If stimulation is needed, strychnin sul. or nit. may be added, beginning with 1/240 gr. (0.0002 gm.) every four hours for a child one to two years old. If necessary they can be alternated so that the patient receives something every two hours. If there is need of further stimulation, caffen cit. can be added, beginning with 1/4 gr. (0.015 gm.) every four hours. These three drugs give the best results in diphtheria. Digitalis, strophanthus, cactus, and camphor may be used, but in my experience they are much inferior to the above. In cases of sudden collapse a hypodermic injection of nitroglycerin, gr. 1/100 (0.0006 gm.), repeated if necessary in 15 to 20 minutes, followed by strychnin, gives the best result. I have occasionally found a fresh infusion of coffee of great value. Care must be taken not to administer any heart depressants such as acetanilid.

Adenitis.—Cervical adenitis is a frequent complication. An ice collar around the neck frequently relieves this entirely. This should not be continued too long, and if the glandular swelling does not subside in about 48 hours it should be discontinued, and hot poultices substituted. Heat will sometimes act where cold does not—if it does not reduce the swelling it causes a rapid breaking down of glands and then they can be incised and drained.

With children it is a good plan to wait until softening is well advanced and the skin over the part is becoming involved before operating. By doing this the incision necessary is quite small, not over 1/2 inch long. The after treatment is lessened and the scarring very slight. The abscess cavity should never be washed out with hydrogen peroxid. If any irrigation is necessary, and it seldom is, a boric acid or 1/6000 bichlorid solution or 1/40 carbolic is all that is necessary. Occasionally the deeper glands are involved and the skin is not involved at all; here we cannot wait, but must let the general symptoms—a septic temperature, continued swelling, rapid pulse—be the guide for operating.

Otitis Media.—Otitis media is seen frequently in both croup and pharyngeal cases. It may develop any time after the onset of the disease, but most frequently occurs at the end of the first or during the second week.

It is caused occasionally by an extension of the diphtheritic process up the Eustachian tube, but in the majority of cases the ordinary pus bacteria are the causal agents.

A great deal has been said and written about irrigation of the nose and throat causing this condition. Forcible irrigation of the nose to remove pieces of membrane or irrigation improperly done may cause it, but with a competent nurse irrigation does not increase the probability of its development. In a series of 152 croup cases which were not irrigated it occurred 44 times, or about 29 per cent. Twenty-eight had involvement of both ears, in nine cases the left ear alone was involved, and in seven cases the right ear alone was involved. In a series of 210 cases

where the larynx was not involved and which were irrigated it occurred 27 times, showing a percentage of 12.8. Of these cases eight showed nasal involvement, while, in 19 cases, there was no nasal membrane or discharge present.

Staphylococci are the most frequent cause of this complication, but occasionally the Klebs-Loeffler bacilli are found. When they are present it is very difficult to get rid of them.

The treatment of this condition in both croup and pharyngeal cases is the same. As soon as bulging is seen in the drum membrane there should be free incision of the membrane, followed by hot irrigations every two to four hours with saturated boric acid solution or 1/6000 bichlorid. After irrigation the external meatus should be thoroughly dried, and if it is desired it can be packed with dry sterile gauze, carefully introducing a small wick of it down to the drum membrane, and covering the external meatus with a layer of it. If this is done properly it acts as a drain, but it should be remembered that it may cause damming back of the discharge, and it should be changed sufficiently often to prevent this. Whatever plan of treatment is adopted it should be repeated often enough to keep the ear clean.

Bronchopneumonia.—Bronchopneumonia is the most dreaded complication of the croup cases. It may occur whether they are intubated or not.

The principal treatment is plenty of fresh air. When the case has been intubated and much mucus is present it is advisable to remove the tube. Frequently much mucus will then be coughed up which would not come up through the tube.

Post-diphtheritic Paralysis.—With the more general use of antitoxin this after condition is becoming less frequent. The treatment is first of all prophylactic. A sufficient amount of antitoxin used early will prevent it. In the cases seen at the present day it is almost entirely limited to the muscles of the pharynx, and is shown by the nasal quality of the voice and the regurgitation of food, especially liquids, through the nose.

In cases where antitoxin is not given it may be very extensive, involving, in addition to the muscles of the pharynx, the muscles of the eye, the arms and the forearms, legs, and also extending to the muscles of the trunk, causing death by paralysis of the muscles of respiration.

After paralysis develops its treatment consists of the use of strychnia in large doses. The dose to be increased to the limit of tolerance. In addition to strychnin, iron is useful. In feeding the same precautions are to be observed as in feeding intubated cases, that is, feed slowly. It may be necessary at times to feed by gavage. The food should be highly nutritious and easily digestible, such as milk, eggs, beef juice, etc.

With injection of diphtheria antitoxin, as suggested by Roux, we have had no personal experience. His theory is that the diphtheria toxin

is anchored to the cells of the nervous system and can be neutralized by antitoxin. For the palatine paralysis he applies it locally, for that due to central changes he injects it. Berhier injects it every day, and Kohts gives large doses, as high as 35,000 units. This plan of treatment should be tried in all cases where diphtheria antitoxin had not been used at the onset, but in those where it has been used the danger of anaphylaxis should be considered, and unless the paralysis is very extensive, and danger of death is imminent, we prefer to rely on strychnia and diet.

Kidney Complications.—Kidney involvement is seen very frequently. The renal changes that take place are according to the amount of toxemia and the effect of the toxin on the renal epithelium. Nephritis is rare. The urine shows a large amount of albumin and a few casts, most frequently granular in type with some hyalin. The condition in the kidneys is seldom permanent. The urine clears up in a few weeks, and no serious trouble is caused by it. The treatment of this complication is rest in bed, milk diet, plenty of pure water, and keep the bowels open with salines. Diuretics are not indicated, and their too free use can set up an acute inflammatory process and cause a true nephritis.

Skin Affections.—The skin should be bathed and kept in a clean condition, but this must be done by sponging in bed, as all other bathing is too much exertion, and a hot bath might prove fatal.

A rare complication of intubation is pretracheal abscess. I have seen five cases of this. The abscess forms in the middle line of the neck about halfway between the larynx and the suprasternal notch. The abscess develops as a rule in about ten days after intubation; it attains the size of a pigeon's egg. It develops in a small lymphatic gland which is situated in this location in front of the trachea, and into which the lymphatics from the larynx drain. The primary site of infection is ulceration at the base of the epiglottis caused by the pressure of the head of the tube. Its treatment is incision and drainage.

TRACHEOTOMY

The instruments and materials needed to perform the operation are a scalpel, scissors, grooved director, two dissecting forceps (plain and toothed), a tenaculum, a pair of small retractors, a bivalve instrument for opening the trachea, two tracheotomy tubes of different sizes, ligatures, needles, sutures, gauze, cotton, etc.

In preparation for the operation the usual antiseptic precautions are necessary. The child should lie flat with the shoulder supported. This aids in extending the neck. An assistant must hold the head firmly in the median line, keeping the chin in line with the sternal notch. Chloroform is the best anesthetic. It is not necessary to administer much. The incision should begin at the upper border of the cricoid cartilage, and a

single stroke through the skin and superficial fascia should carry it at least two inches in the median line. Several veins come into view. These are usually swollen with the dyspnea. They should be cared for, and the communicating branch of the anterior jugular vein should be ligated before cutting.

The handle of the scalpel is now used to loosen the sternohyoid and the sternothyroid muscles, which are then retracted. The deeper fascia is then nicked, a director passed under. It can then be divided without danger of wounding important vessels. The trachea and the thyroid isthmus then come into view. The isthmus usually crosses about the third ring or a little above it. It may be retracted downward or can be divided if necessary, first ligating on either side. All hemorrhage should be checked before the trachea is incised. To open the trachea steady it with a tenaculum. The scalpel is held close as a pen in writing so that the blade will not project more than half an inch beyond the finger to prevent its entering too deeply; and a cut made, beginning with the third ring upward to the cricoid cartilage. This latter may also be severed if necessary. A bivalve instrument or dilator is now thrust into the wound to separate the parts for the introduction of the tube. There is generally a marked increase in asphyxia as the operator proceeds. Respiration frequently stops during the operation, and it is necessary to supply artificial respiration until there is a return of the rhythm. The tube is held in place by a tape. A simple dressing of gauze completes the operation.

CHAPTER XV

ERYSIPELAS

GEORGE DOCK

Definition.—"Erysipelas is an infectious disease characterized by a peculiar inflammation of the skin, with fever and other general symptoms," caused by a streptococcus discovered by Fehleisen.

Etiology.—Erysipelas, as observed clinically, is always caused by streptococci culturally and morphologically identical with streptococcus pyogenes. In some lower animals other germs, especially pneumococci, staphylococci, and colon bacilli, cause similar lesions, but cases in human pathology are very rare. Von Leube has described a pneumococcus case caused in a patient with pneumonia by boring the nose.

Predisposing and Assisting Causes.—Erysipelas was formerly an almost universal complication of operations and wounds in surgical wards. Since the advent of surgical cleanliness it has become practically extinct as a surgical disease, and is seen usually in private practice, in medical wards, and in asylums. It is kept out of large wounds without special precautions other than aseptic technique, but it occurs without discoverable cause, or following a trifling scratch or abrasion. An aged physician, rising suddenly, injured his scalp on the sharp point of an electric light bulb. Severe erysipelas followed immediately. It may take its starting point in an eczema, acne, or lupus; in the excoriation on the lip from a rhinitis; in a pruritis of the perineum or vulva; in a vaccination wound; after leech bites; boring for earrings; the umbilical cord; the uterus post partum. Septic diseases of the nose, throat, and ears are among the most important causes in medical wards, and the danger must always be borne in mind. In so-called cryptogenetic cases it is not necessary to assume an unseen wound. The germs are often present on the body. A local alteration of nutrition in the skin or mucous membrane, or the assistance of another germ, such as the colon bacillus, may furnish a favorable seat, or more favorable conditions for the multiplication and increased virulence of the germs.

Erysipelas is still spoken of sometimes as a contagious disease, in the sense that it is communicated through the air, or without direct contact.

As the facts on which the belief is based occur more often in private houses than in hospitals, and more often in medical than in surgical wards, it is more likely that casual transfer has taken place. The streptococci are easily destroyed where they are known to be present, but can live long under conditions that include careless handling of dressings, eating and drinking utensils, and other small articles of personal use. It has been thought to have been transmitted by body lice in the plush seat of a railroad car.

Individual predisposition to erysipelas is an important but obscure fact. The disease occurs chiefly in early middle life, but is not uncommon at the extremes of age. It is more frequent in women than in men. The cold, wet months of late winter and early spring furnish a large proportion of cases.

Pathologic Anatomy and Pathology.—Erysipelas produces a sero-fibrinous inflammation of the skin, the cocci growing in large numbers in the lymph spaces. Their soluble toxins cause degenerative changes of various kinds and degrees. The process varies in depth in different cases and may extend deep in the corium. The process also extends laterally and involves the blood capillaries and lymphatics. It may reach the regional lymphatic glands, but rarely causes general septicemia or metastatic foci. Suppuration and necrosis are possible results, but suppuration, when it occurs, is sometimes the result of secondary infection by staphylococcus aureus or albus. Leukocytosis is almost always present. The general symptoms are due to the toxins produced by the germs.

Symptoms.—The earliest symptoms of erysipelas are the common phenomena of sepsis—malaise, loss of appetite, lassitude, or febrile exhilaration, etc. The stage of incubation varies from two days to two weeks. A distinct chill is almost constant as the first marked symptom. Sometimes there is a series of slight chilly feelings. Vomiting, nausea, prostration, and fever then follow, the temperature reaching 102°-104° F., or even more, and continuing as a remittent or intermittent fever. Delirium is often present during the early febrile stages. For one or two days the diagnosis may be in doubt, especially if exposure is not known. Lymphatic tenderness may be present, or there may be pain or a feeling of tension in the skin without evidence of trauma or infection. Epistaxis occurs sometimes when the primary focus is in the nose.

The characteristic lesion is a flat swelling of the skin, with a distinct abrupt edge, a rather rough surface, of more or less distinct red color. It occurs chiefly on the face, in the region of the nose, ear, mouth, and, in typical "medical" erysipelas, produces a butterfly-shaped area of disease, with its center on the nose. The affected skin feels hard and stiff. It enlarges by irregular advances at the edge, and is often checked where the skin is closely adherent to the deeper tissue. The swelling is greater where the deep tissue is loose, as in the eyelids. The scalp is often in

volved, and when so temporary loss of hair follows desquamation. The surface may become vesicular, or may suppurate or become gangrenous, the deep tissues may be involved, causing an inflammatory edema, or may go on to abscess formation.

The fever lasts during the active stage of the skin process, the whole length of the disease being from a few days to two weeks, or longer in some "migrating" cases. After the inflammation subsides, desquamation follows. The affected area may long remain hyperemic.

Erysipelas of the nose, mouth, and pharynx is occasionally observed. It does not require special description, as the phenomena and treatment are those of septic inflammation, and the diagnosis of erysipelas should not be made unless there is an extension to the skin.

Complications and Sequels.—Suppuration of adjacent sinuses is not uncommon; albuminuria with casts is almost constant, but does not often result in permanent kidney disease. Affections of the heart and pericardium are rare; pleurisy and pneumonia also. Peritonitis has been observed, especially in cases affecting the female genitals. Serous effusions in one or many joints may occur, less frequently suppurative arthritis.

Diagnosis.—The diagnosis of erysipelas is not difficult after the skin lesion appears. Before that, all infections must be thought of and searched for by appropriate methods of examination.

Prognosis.—The prognosis is extremely variable. In previously healthy individuals, not in the extremes of age, erysipelas is, even if severe, usually followed by complete recovery. In the young—all newborn and almost all under one year die—the old and the cachectic, in diabetics, hard drinkers and arteriosclerotics, it is dangerous—often fatal. Erysipelas of the mucous membrane is serious; erysipelas of the scalp not always so.

Erysipelas does not produce immunity, and often seems to increase the disposition to renewed infection. Many cases are known of yearly relapses, or even much more frequent ones.

TREATMENT

Internal treatment for erysipelas there is none. The iron and quinin so long used and still recommended are useless against the disease. In patients with other diseases appropriate treatment may be continued, unless contraindicated by special symptoms.

General measures should be carried out as for other diseases. The vomiting of the onset should be allayed by draughts of hot water. A mild cathartic is usually beneficial.

The diet should be simple and limited to liquids for the first few days

at least. Water or dilute fruit juices should be given freely. It is usually more comfortable for the patient to be in a cool, rather dark room.

Symptoms may be met as under other conditions. The fever, as a rule, does not require treatment, but, if it seems to, small doses of such antipyretics as phenacetin (gr. iii, gm. 0.2) may be used. Tepid sponging is beneficial, but cold, full baths are not necessary, except in highly septic cases.

For headache, restlessness, or sleeplessness, a full dose of sodium bromid (gr. 40-80, gm. 3-6) should be given as necessary. If sleep has been lost, a full dose of chloral hydrate may be added (gr. 15, gm. 1.0).

In potators the heart must be watched. Caffein, digitalis, or camphor hypodermically should be begun as soon as the need is suspected.

Serums and vaccines have been used, including the serum of patients recovered from erysipelas, in doses of 8 c. c., but without showing real efficacy. Fornaca thinks the serum is not bactericidal, but lessens the virulence of germs. Both homologous and heterologous sera and vaccines, simple and polyvalent, have been used. Diphtheria serum has also been used by Chapiro, Tomaselli, and others, with good results. It must be remembered that erysipelas is a disease of varying severity and irregular course. Many cases begin severely, but soon subside. All kinds of drugs as well as charms and incantations have been used with great satisfaction to their originators, but one should meet claims for sera and vaccines with the same criticism that we do toward iron, quinin, and other drugs, and require definite results comparable to that of quinin in malaria, or diphtheria antitoxin in diphtheria, before accepting recommendations or following them in practice.

Local treatment offers many methods. All sorts of local sedatives have been tried, dry, wet, and in unguents. Some old popular remedies, like brewers' yeast, are revived from time to time under the stimulus of hypothesis. Among all local preparations, ichthyol, in the opinion of the writer, deserves first place. It is astringent, and so lessens the painful sense of swelling in the skin; it has an antiseptic action in the test tube, and, although in the body this can hardly be very great, the results in practice are apparently superior to those of simple compression methods, or to antiseptics like iodine. It can be used as an unguent, diluted with vaselin—1 to 4—or as a varnish (Unna's formula):

R	Ichthyol	gm. 40.0
	Starch powder	40.0
	Egg albumen	1.5
	Water to make	100.0

or combined with collodion or traumaticin, 1-3 or 4.

Before using ichthyol in any form the skin should be carefully washed

with soap and water. The ichthyol should then be rubbed or painted on, beginning about an inch beyond the margin of inflammation and covering all the affected part. If the margin advances, the ichthyol should be applied beyond it as often as necessary. If relapse occurs the same treatment should be repeated.

The writer would like to recommend another method of treatment, based upon a different principle. I refer to the artificial hyperemia of Bier. This can be brought about by hot air from any convenient source, but is most conveniently done by the bandage kept on continuously, either 11 hours or 23 hours at a time, with an intermission of an hour. In the case of erysipelas of the face a gauze bandage should be put on the neck and a garter elastic, furnished with hooks and eyes, fastened on with just enough constriction to cause moderate congestion of the face without mottling and without pain. On the extremities the usual compression bandage should be used.

More heroic methods of treatment have been almost entirely abandoned in practice, though not in text-books, and in severe cases may at times be resorted to. The chief methods are those of Hueter and Kraske-Riedel, and consist in the use of free incisions into the affected part, with compresses saturated with carbolic acid, 3 per cent., or bichlorid of mercury, one per one thousand.

Treatment of Complications.—Mild vesiculation requires no treatment. If suppuration occurs the parts should be kept as clean as possible. Ichthyol or other antiseptics may be used. Gangrene is to be treated on surgical principles.

Meningitis is to be suspected when cerebral symptoms are severe. It is rarely present. but when it is, should be treated as under other circumstances.

The healing of other diseases by erysipelas toxins does not seem to belong to this chapter, but it may be mentioned that various diseases besides tumors have seemed to be favorably influenced by an attack of erysipelas. Feilchenfeld has reported the healing of blennorrhoea of the lacrimal sac, Stadler one of pernicious anemia.

CHAPTER XVI

SEPTICOPYEMIA

GEORGE DOCK

Definition.—The word septicopyemia is a convenient one by which to designate certain forms of infection still incompletely known, or at least impossible thoroughly to understand during the life of the patient. It replaces with advantage some terms that came into use before the details of infection were as well known as they now are, but it is in truth a collective word, and is as objectionable as “fever” or “dropsy,” but on account of the practical difficulties of exact microbial diagnosis it may be used until the various infections that now enter into it can be distinguished, as we now distinguish typhoid and recurrent fevers. It replaces, especially, two older words that came into use before accurate ideas on the subject were possible, and that are still used rather loosely, but without realizing the latter fact.

“Septicemia” is applied to conditions in which there is microbial invasion, usually bacterial, of the blood and tissues, without foci of suppuration. It is more comprehensive than “bacteremia,” which appeals to many as more precise.

“Pyemia” is an old term now used in the sense of an infection with a pus focus, with intoxication—still spoken of as “toxemia”—from the poisonous substances formed by or from the germs in the focus, or from the tissues affected by the germs or their products. It is still a part of the conception of pyemia that metastatic foci may be set up by the action of germs carried from the primary focus. It is obvious that the differentiation of such cases from cases of septicemia depends upon methods that are useful only when positive. Negative results often depend chiefly upon imperfect search. The source of a septicemia may be known, and its character determined by the examination of material from the source, as in puerperal disease.

On the other hand, the local disease may be due to one germ, the general disease to a different one, as we see in staphylococcus infection originating in gonorrhea, or a streptococcus septicemia that has entered through a staphylococcus skin infection.

In many cases of septicemia and septicopyemia there is no discoverable local lesion during life. To such the term "cryptogenetic" is applied. In many cases no primary focus can be found in the most careful search post mortem, either because the primary focus or portal of entry has healed, or because there was no portal in the sense of a gross solution of continuity, the germs having entered through the skin or mucosa and having found unusually favorable conditions for growth.

Etiology.—The causes of septicopyemia are numerous. The most important are streptococci, staphylococci, pneumococci, including the nearly related micrococcus viridans, colon bacilli, influenza bacilli, proteus, pyocyaneus, and anthrax, but other germs, such as typhoid bacilli, micrococcus tetragenus and Friedländer's bacillus, may be concerned.

From the list given it is clear that the practitioner should always attempt the exact diagnosis, just as he now aims to distinguish between typhoid fever and miliary tuberculosis. That he does not depends not so much upon force of habit, which has made the idea of septicemia as satisfactory to many as that of typhoid, as it does upon the practical difficulties in the exact diagnosis. Another reason is that the treatment of such disease must necessarily be upon a rather general basis. But even if the efforts at specific treatment have so far been disappointing, it will only be after we are able to distinguish each form of infection that we can draw accurate conclusions as to the result of treatment in actual cases.

Pathology.—The pathologic anatomy involves the specific lesions, if the germ is one that can produce such; or there may be a primary focus, as said before, which may be very minute. From this focus bacteria may be swept out or get into the lymph or blood circulation, and by their presence or by their poisons, absorbed from them, produce other lesions or symptoms. We know little about the entrance of germs into the circulation, but we know that in some cases such invasions are very irregular in time and number of germs set free. The toxic effects may be so slight as to be unnoticed; or so severe as to cause the most striking clinical phenomena.

Among the local lesions, next to suppuration, thrombosis and embolism are most important features. The thrombosis usually originates in an infectious phlebitis or arteritis. No satisfactory reason can be given for the fact that in some cases suppuration is severe, in others there is phlebitis or endocarditis, in others none of them, but marked growth of bacteria in the vessels, especially in the capillaries.

Symptoms.—The symptoms of septicopyemia are of great diversity and of all degrees of severity. Chills, fever, sweating, especially intermittent fever with great excursions, sometimes as much as 8 or 10 degrees Fahr., within a few hours, collapse temperature and cardiac arrhythmia, are perhaps the most striking. Malaria is still too often sus-

pected, and still other so-called tropical diseases, such as Malta fever. Enlargement of the spleen is almost the rule in septicopyemia. Sometimes sudden pain and tenderness in the splenic region permit the diagnosis of infarct, which may lead to more accurate diagnosis than was possible before. Weakness, headache, anorexia, malaise, emaciation, sallow or subicteroid complexion may be the chief features in another class. Besides headache, dizziness, insomnia, convulsions, delirium, and coma occur, especially when there is thrombosis or embolism or suppuration within the cranium. Retinal hemorrhages also occur. Leukocytosis is a frequent sign, but in some cases there is the blood picture of a primary anemia without leukocytosis. Joint pains and arthritis of all varieties are the characteristics of others; osteomyelitis is always to be looked for. Petechiæ or larger skin hemorrhages, hematuria, or blood spitting are sometimes the clues to the existence of septicemia.

Endocarditis is a frequent accompaniment of septicopyemia. Many cases diagnosed as the former are really cases of septicemia or septicopyemia, in which the heart shows conspicuous symptoms; enlargement of dulness, weak muscular sounds, murmurs, and irregular rhythm are usually present. Very often the enlargement of the heart is slight, either on account of the lesion being mitral stenosis, or because of the fact that from the feeling of weakness and tendency to high fever the heart is spared the exertion that would otherwise cause enlargement.

Diagnosis.—The diagnosis may be made in many cases by a carefully taken history, with temperature record, and accurate physical examination, including that of the blood. Exclusion of diseases that might cause a similar picture is an essential part of the work. The most important single diseases to differentiate are rheumatism, malaria, typhoid fever, and miliary tuberculosis; next to these other acute infectious diseases, only necessary to consider in the early stages; later, with emaciation and anemia, chronic blood and constitutional diseases must be excluded.

The diagnosis should always be completed by blood cultures, and cultures from any suppurative foci that may be found. As this is work that can only be done by experts, it is not necessary to go into details. In order to make the findings of scientific value the most exact differentiation of germs must be made, as in the case of germs of the colon group.

Prognosis.—The prognosis depends partly upon the nature of the germ, partly upon the severity of the infection, the previous health and resistance of the body, and the ability of the patient to secure proper treatment.

Bodily resistance cannot always be estimated, but we know that the old, the drunkard, the diabetic, the cachectic, and the arteriosclerotic react badly to all infections.

Streptococci usually give a bad prognosis. Recoveries have been re-

ported from all forms, so that an absolutely hopeless prognosis should not be made merely upon the discovery of a septicopyemia.

If a local lesion susceptible of surgical treatment can be found, the prospects are often better than in purely cryptogenetic cases.

The duration of the disease before the discovery has an important bearing upon the prognosis. Many cases of pyemia from various causes are amenable in the beginning, but almost wholly intractable after septicemia is well developed. Colon bacillus infections are especially difficult to eradicate when of long standing, as compared with their early stages.

TREATMENT

Prophylactic Treatment.—Prophylactic treatment of septicopyemia is one of the chief aims of Listerian surgery. This is probably not realized as universally as it should be, and numerous cases of local infection in the skin, bones, and peritoneum, gastrointestinal and genitourinary tract, ears, and other organs are permitted to go on unchecked. The fact that many cases never cause serious trouble explains the common neglect, but cases of malignant endocarditis, of brain abscess and of general sepsis develop out of them often enough to show, as in other diseases, that none can safely be considered trifling.

Surgical Treatment.—Surgical details need not be described here. Radical healing, as early as possible, is the aim.

Specific Treatment.—Specific treatment should be experimented with in various ways until the possibilities are exhausted. Even medicinal assistance for this object must not be abandoned. The early objection to such efforts—that it is impossible to use antiseptics that will not be more dangerous to the host than to the germs—is based upon an imperfect knowledge of the facts, though true in general. We know that different kinds of organisms show different degrees of sensibility to various poisons. The treatment of intestinal animal parasites illustrates this. The field, so far from being exhausted, has only been touched. New preparations are sure to be invented that will have peculiar advantages and minimal disadvantages. Such preparations as colloidal silver salts, urotropin, and salicylates have brought disappointment to many, but in the results of their use we can find numerous suggestions for further trials, carefully observed and accurately controlled. It does not seem necessary to lay down rules for the administration of any of these preparations, but one general rule should be emphasized: that they must be used early, and not deferred until the body is overwhelmed with infectious material. Another feature in the use of these and other similar substances is the importance of intravenous medication, as well as the more definite trial of intramuscular injections.

The use of sera and vaccines has been disappointing in many forms of sepsis, and the differences of action of some of these infections, as compared with that of diphtheria and tetanus, has made many deny the possibility of future improvement. This may be the final verdict, but it is too early to abandon further investigation, and all methods that appear promising from experiments on animals should be followed up in appropriate human subjects.

Owing to the experimental character of the treatment and the fact that it should only be used where complete bacteriologic examinations are being carried on, with such other examinations as are indicated—opsonin determinations, hemolysis tests, complement fixation, etc.—details must be worked out in each case. In practice, even with the most careful examinations, trials may be made of various preparations besides those of the germs cultivated, but without such cultures and all the other work the treatment cannot be considered any better than the crudest empiricism.

Symptomatic Treatment.—The symptomatic treatment offers many details of importance. The possible dangers from exertion must be avoided by proper nursing. Fresh air treatment is often of decided advantage, and patients with severe symptoms should be in the open air, with all the necessary details. On general principles, as well as on account of the danger from imperfect excretion of waste products in cases of infection, the alimentary canal should be unloaded early and retention prevented by the use of enemata or colonic flushing at intervals. The function of the kidneys should be carefully observed, and stimulated by a sufficient amount of water regularly. Although the early hopes of tissue irrigation have been disappointing, the systematic use of physiologic saline solutions has advantages in washing out toxins and in keeping up the vascular and cardiac tone. The slow proctoclysis, as improved by Murphy, is the best way of using salt solution, giving 500 to 1,000 c. c. from one to three times a day.

The food should be simple, easily digestible, and supporting. Eggs and milk are usually the chief elements of the diet. Broths, gruels, purees, and fruit juices, arrowroot and cornstarch preparations, and fruit jellies are useful aids. Tea, coffee, and milk or cocoa serve as stimulating beverages.

The question of the value of alcohol in septicemia is still unsettled. As a routine, I have for many years wholly excluded it in the treatment of all infections, and I have not been able to recognize any loss as compared with other cases treated formerly by myself, or now by other physicians. Perhaps as substitutes for food or as psychic pseudo-stimulants they may be useful at times, but I believe that hot drinks, hot saline enemata, ice bags to the precordium, or the cold, full bath are more useful general stimulants.

Certain other remedies may be used for vasomotor or cardiac weak-

ness. Among these are caffein or strong coffee, strychnin, digitalis, and camphor, the latter hypodermically in the form of camphorated oil [also adrenalin.—Ed.].

The gastric irritability of sepsis should be treated with cathartics and diet. The diarrhea, which may be an important, even vital, factor, should be treated by cathartics, such as calomel or castor oil, colonic flushing, and such remedies as salol, bismuth, and betanaphthol.

Pain should be treated with analgesics like aspirin, phenacetin, or morphin, according to the indications. Efforts should be made to secure sleep by the use of veronal, trional, bromids, and morphin.

Delirium calls for the ice bag and hyoscin hydrobromate.

Organic diseases like pneumonia must be treated as under other conditions.

The danger of heart and vasomotor weakness must always be borne in mind. Even late in convalescence no sudden or prolonged exertion should be permitted. If there is endocarditis, the precaution must be most minute.

CHAPTER XVII

ACUTE RHEUMATISM

(Rheumatic Fever, Polyarthritis Infectiosa Acuta Idiopathica)

CHARLES LYMAN GREENE

Definition.—An acute febrile disease, associated with more or less profuse acid sweats, and characterized by an exudative, nonsuppurative inflammation of the joints and a peculiar tendency to secondary involvement of the endocardium, pericardium, and heart muscle.

Course and Development.—Its development and course distinctly suggest an acute infection of the septic type, but suppuration is uncommon, and the direct mortality does not exceed two per cent., being due usually to cardiac complications of the malignant type, or to profound toxemia manifested by hyperpyrexia and major cerebral symptoms.

It involves chiefly the larger joints, often in an orderly, progressive sequence, transferring its maximum of swelling and pain from one joint, or pair of joints, to others. If untreated, it is of long duration, and, in any event, is peculiarly likely to recur at longer or shorter intervals, unless a primary focus of infection is demonstrated and removed. Its toxin affects the valves or the heart muscle with peculiar frequency, the pericardium or pleura less often, the peritoneum rarely. Its chief effects appear in the mitral valve and the left heart chamber, this being especially true in childhood, during which period aortic lesions are relatively rare. Its almost specific response to certain remedies and radical procedures is of etiologic, diagnostic, and prognostic value.

Portals of Infection and Causative Agents.—The onset and course of acute rheumatism have long suggested the presence of a germ as a causative agent, and, in the light of reports made during the last decade, it becomes extremely probable that one or possibly several organisms are capable of producing it. The old metabolic theories, in which both uric and lactic acids played a prominent part, must be abandoned in the light afforded, not alone by the lack of proof offered in support of such assumption, but by the reports dealing with the recovery of germs from the joint tissues, exudates, endocardial vegetations, and, in rare instances, from

the blood of rheumatic patients, and also the surprising results of painstaking research into the actual portals of infection.

Achalme has reported an anaerobe resembling the anthrax bacillus, but his findings have not been sustained. Mantle, Klebs, Singer, Popoff, Leyden, Chvostek, Michaelis, Poynton and Payne, Westphal, Wassermann and Malkoff, Beattie, Ainley Walker, Beatson, Longscope, and others have reported a diplococcus or diplostreptococcus, and this organism has been repeatedly recovered, grown in pure culture, and shown to produce consistently an acute arthritis in a large series of rabbits by inoculation.

The diplococcus sometimes appears like a short-chain streptococcus, and is regarded by Poynton as a streptococcus in its "family" resemblances, and a diplococcus in relation to "species."

This organism is recovered from acute rheumatic lesions, but is rarely found in the blood or joint exudate, though very readily, according to Poynton and Payne, Beattie, and others, in the areolar tissue underlying the synovial membrane. It is, perhaps, significant that it cannot be differentiated from the streptococcus pyogenes by any specific test. On the other hand, it grows by preference, though not consistently, in diplococcus form.

It is extremely small. It retains Gram's stain but feebly. It shows greater resistance to drying. It produces acid earlier and more profusely than the streptococcus pyogenes. It grows readily in filtered cultures of that organism. Its grade of virulence is lower, and its tendency to produce abscess still less than that of the streptococcus pyogenes itself (Poynton).

So far the profession, as a whole, has not been willing to accept these diplostreptococci or any single organism as the specific cause of the disease. On the other hand, the numerous reports bearing upon the intimate relationship between infections of the tonsils, accessory sinuses, and pharynx, in relation to rheumatism and endocarditis, go far to indicate, not only that rheumatism is an infection, but that it is associated in an extraordinary number of cases with chronic or acute tonsillar infections associated with the presence of the streptococcus and staphylococcus pyogenes, the former being by far the most frequently isolated organism.

Series reported by many observers show that the tonsils in such cases not only contain most frequently the streptococcus pyogenes, often in pure culture, but that individual cases yield in most instances strains differing more or less widely from this organism as found in other lesions.

D. J. Davis, for example, in an investigation of forty-five cases of rheumatism, found a diverse flora on the surface of the tonsils, but in the crypts pure, or nearly pure, cultures of a streptococcus, representing various strains, nearly all of which, when injected into rabbits in small

doses, produced an arthritis, in larger doses a septicemia. From the joint lesions the streptococci could be recovered and regrown. In these animal cases, however, the joint effusions tended to become purulent, and the animals lived but a few days.

The striking efficacy of the salicylates in tonsillitis is of interest, and the results of radical extirpation of the tonsils in patients afflicted with recurrent rheumatism are most suggestively favorable. Certain authorities, notably Guerich, are now advocating operation, even during an acute attack. Such operations produce a temporary exacerbation of symptoms, but are undoubtedly effective in many instances as the writer can testify from a personal experience. At present the profession, as a whole, is not prepared to accept such radical procedure during an attack, but is more and more strongly in favor of a complete enucleation in the intervals.

The writer would have no hesitancy in recommending the radical procedure in lingering or persistently recurrent cases if the general condition of the patient and the condition of the heart justified any surgical undertaking.

It would seem probable that many or most of the cases of acute rheumatism represent the effects produced by the entrance into the blood of pyogenic organisms, modified by their residence, repeated reproduction in and passage through the tissues in which they were originally lodged, which afford them prolonged periods of incubation and supply the very conditions which would be likely to produce modifications of their primary characteristics and virulence.

That organisms capable of producing such an infection as rheumatism may be found in and on the tonsils, diseased teeth and gums, the nasal sinuses, the nasopharynx, the antrum of Highmore bronchiectases, and other foci seems more than probable at the present time.

The question of chronic toxemia in relation, not alone to minor rheumatic manifestations, but also to certain of those peculiar conditions so frequently found in association with acute rheumatism and tonsillar inflammation is worthy of consideration. Erythema nodosum, purpura, urticaria, angioneurotic edema, and the like are frequently encountered, and their intimate relationship to both active and larval rheumatism has been seriously considered for many years on clinical grounds alone.

In the same connection we may hope to find an explanation of those obscure inflammatory cardiac lesions lacking a frank rheumatic history or even a definite admission of the patient's tonsillar or other focal infections.

It would seem from the reports of many skilled observers that not only may the tonsils be seriously diseased and filled with pathogenic organisms without serious disturbances recognizable by the patient as an angina, but that these organs may appear quite normal upon casual

examination, even while acting as incubators for pyogenic cocci and oftentimes containing pus in considerable quantity.

The effect of necrotic processes in so susceptible and permeable a tissue as the tonsil and the varying grades of toxemia produced by the absorption of such materials must be given consideration. Even in the absence of a genuine bacteriemia the body tissue may be profoundly affected by the materials produced by persistent germ activity and resulting tissue destruction. Such incidents are no doubt of special frequency in childhood and early youth, at which time they may produce no more evidence of rheumatism than so-called "growing pains," which have long been recognized as constituting in the child sufficient ground for a diagnosis of that condition.

Poynton quotes Dr. Cheadle's excellent summary of the general grounds upon which one assumes that acute rheumatism is an infection:

"The occasional epidemic prevalence, the variability of type, the incidence upon the young, the occurrence of tonsillitis, of endocarditis, of pneumonia, of erythematous eruptions, the rapid anemia, the tendency to capillary hemorrhage and acid albuminuria; the implication of the joints, the relapses, the occasional supervention of hyperpyrexia, the nervous disturbances, the specific power of salicylic acid, are all suggestive of an infectious disease."

We can go little beyond this assertion at the present time. However valuable and suggestive the offerings of modern research, however strong our individual belief in the imminence of conclusive results, we must admit, nevertheless, that neither the finding of certain germs in the affected tissues nor the production of arthritis in animals inoculated with the recovered organisms is sufficient to prove these the *specific causative factors*, for, as Poynton says, many diseases are associated with an arthritis, or even an endocarditis, and many germs are competent to produce these conditions in animals.

It has been shown repeatedly that arthritis may be caused by the gonococcus, various streptococcus strains, bacillus coli, influenza bacillus, bacillus typhosus, micrococcus melitensis, tubercle bacillus, the spirochete of syphilis, and the plasmodium malariae, as well as by the unknown causative agents of measles and scarlet fever and a diphtheria-like bacillus obtained by Drs. William Murrell and Braxton Hicks in gleety discharges.

On the other hand, one must admit that the streptococcus or diplococcus heretofore described is found with remarkable regularity by Poynton and others, and produces in susceptible animals the chief lesions and complications of acute rheumatism with suggestive constancy. The fact that the arrangement of the organism is sometimes that of a diplococcus and at others that of a streptococcus is especially interesting in its relation to the findings reported by those investigating the flora of diseased tonsils. Furthermore, as recent statistics show a preëxistent or coincident tonsillitis in eighty per cent. of the cases of acute rheumatism, to which may

be added the growing recognition of the fact that oftentimes an acute or extremely slight tonsillar infection antedates the arthritis by three weeks or more, we must admit the close connection between certain known infections of demonstrable etiology and the phenomena described under the head of acute rheumatism.

TREATMENT

PROPHYLAXIS

It would seem that proper care of the nose, throat, and teeth in children and adults alike constituted the first factor in the light of our modern knowledge, and with this one should consider the necessity for prompt and radical treatment in relation to chronic infections of the upper air passages, and especially with regard to the tonsils.

Indeed, the early removal of adenoids and diseased tonsillar tissue especially represents an imperative necessity, not alone because of the relationship between focal infections and acute and chronic arthritis but because of the retarded development and impaired nutrition which may and undoubtedly does influence the entire after lifetime of such unfortunates.

A family history of rheumatism, delicacy of structure, and poor nutrition should make one especially solicitous concerning any child.

Aside from this, properly regulated exercise, fresh air, the proper choice of an occupation, proper clothing, and the avoidance of sudden chilling of the surface in the presence of poor nutrition and fatigue are the chief matters to be considered.

INDICATIONS FOR DIRECT TREATMENT

One must consider, first, pain; second, fever; third, the swollen and tender joints; fourth, the tendency to profuse acid sweats; and, fifth, the liability to complications, especially on the part of the heart.

The first and primary necessity is absolute, prolonged rest in bed, and this rest should be both physical and mental, inasmuch as such patients are usually irritable, excitable, intolerant of noise, and most apprehensive of jarring and handling of any sort.

There is no disease in which a trained nurse plays a more important part, and she should be given absolute authority as the physician's deputy in the sick-room.

She will endeavor to secure quiet, sunlight, an abundance of fresh air, and a uniform temperature in her patient's room.

She will endeavor to secure a bed of the proper height with good springs, a hair mattress, and an abundant supply of bed clothing.

Whenever possible a single or three-quarter size bed should replace the double bed.

She will arrange the garments worn by her patient so that they can be opened both front and back to facilitate examinations, and the frequent changes of clothing required on account of the profuse sweating incident to the disease and often increased temporarily by the form of treatment usually adopted.

In cases where the pain is severe and persistent, immobilization of the affected joints affords great comfort to the patient and is easily achieved by splints, the free use of cotton to provide packing, and a flannel bandage.

Some prefer to use the plaster of Paris cast, and in certain instances it is of great value. Ordinarily, however, it is a nuisance to apply, difficult to remove without giving the patient pain and is likely to be left too long in situ and necessitate more after-treatment to secure mobility of the joints than would ordinarily be required. In most cases, according to the writer's experience, the free use of cotton to pack the joints, light flannel bandages, and a proper use of pillows for support have made the use of actual fixation apparatus quite unnecessary.

The prolonged use of splints is seldom necessary or wise because of the prompt subsidence of pain under treatment and the tendency on the part of the disease to shift its seat after a few days.

In severe cases it is often perfectly justifiable and indeed indispensable that morphin should be used until the patient is fully under the influence of the anti-rheumatic remedies prescribed.

The greatest care should be observed in its use, and, whenever possible, the nature of the remedy should be unknown to the patient. The same or greater necessity exists for its avoidance in minor subsequent attacks as during the course of the disease.

The preparations of opium are invaluable as a temporary emergency measure, but pernicious and dangerous when otherwise employed, for in such patients morphinism is very easily established.

With respect to the clothing of the patient there is some difference of opinion, but most physicians prefer the use of flannel next to the skin, and some would use light blankets in place of sheets. Against this latter plan there is much to be said on the part of both the nurse and the housekeeper, and if the sheets are frequently changed and the patient's own garments are soft and warm it is in most instances unnecessary to replace sheets by blankets.

Rheumatic patients are peculiarly sensitive to changes in temperature, and every effort should be made to avoid direct drafts and sudden temperature variations. This need not hinder proper ventilation.

If any actual chill is experienced at any time the promptest measures should be taken to procure a reaction by the use of external heat and additional bedding. It is, however, wise to keep the actual covering as light as possible and the room warm, as the weight of the bed clothing is often a torment to the sufferer, who must at times be furnished with cradles or some other device that will remove what to him is an unbearable weight. The experienced nurse will often pin the bed clothes to the footboard of the bed instead of tucking them in in the usual manner and protect the patient by the proper draping of an extra blanket or rug.

The clothing requires frequent changes, and, in view of this fact, the value of having the garments open front and back will be at once appreciated.

Such patients do not need to be fully bathed at frequent intervals, but will usually endure and even enjoy a gentle sponge with very hot water (with or without alcohol), which should be renewed as soon as it feels anything but hot to the patient.

The diet need not, and should not, be of the starvation variety, but should contain a sufficient number of calories to maintain the patient's nutrition, and at the same time be simple and easily digestible.

During the height of the fever a liquid and semi-solid regimen is indicated, though, as rarely happens, if the patient desires some simple but more substantial feedings and eats with relish, he may be allowed them. With the subsidence of fever, the clearing of the tongue and reëstablishment of appetite, his feeding should be promptly increased. In this disease appetite is usually replaced by indifference or even repugnance to food and the patient is careless alike of savor or flavor.

Lactone is an admirable food if properly prepared, but if fresh whole milk be preferred the patient should take not less than two quarts in twenty-four hours.

It is well to dilute the milk by adding boiled water equal to one-half its bulk and 30 grs. (2.0 gm.) sodium citrate should be added to each pint (500 c. c.).

The excessive thirst resulting from the fever and profuse sweating should be met by the free exhibition of water, preferably in the form of alkaline mineral waters, imperial draught, barley water, or slightly sweetened lemonade and free water drinking should be encouraged throughout the entire course of the disease.

TREATMENT BY DRUGS

The first step in prescription writing consists in ordering a dose of calomel to be followed by a saline cathartic, and if the attack be severe it will be necessary to order an opiate to relieve the distress involved in the employment of the bedpan and other necessary procedures.

The vital matter in relation to specific treatment is to choose the main drug and so administer it as to bring the patient under its influence in the shortest possible time.

Some excellent authorities still adhere to the doctrine of no drug

medication in mild cases of acute rheumatism, but in the light of modern knowledge it would seem that such advice is not only faulty but actually dangerous.

If, in dealing with rheumatism, we are facing a condition of toxemia, and if we have any reason to believe that the toxin is derived from the reaction of susceptible tissues to pathogenic organisms, we certainly should use at once and radically those remedies which experience has shown to be of especial value in combating the toxemia.

Something should be said with relation to the continuance of drug treatment after the subsidence or marked amelioration of active symptoms is secured. There would seem to be no adequate reason, no such danger in prolonged administration in the case of most of the drugs used in rheumatic fever as would justify the abrupt and complete withdrawal of the medicines as advocated by some clinicians.

On the other hand, it may justly be asserted that too hasty withdrawal of what is essentially specific medication may result not only in the early recurrence of the disease, but in cardiac complications which might otherwise have been avoided. This is not to be taken as an assertion that the salicylates or any other group of drugs directly affect the course of an endocarditis when this is once established. They are one and all singularly impotent under such conditions. On the other hand, they do serve to shorten the course of an infection which by its continuance threatens the heart.

It is the custom of the writer to reduce the dosage of the medicines employed but to continue them for two weeks at least after all symptoms of an acute infection have subsided. This may and often does necessitate the use of a second choice drug, but it is easy to find one that permits of long-continued effective use.

Salicylic Acid and Its Congeners.—Many practitioners still prefer the salicylic acid crystals in hourly or two-hourly doses of $7\frac{1}{2}$ grains (0.5 gm.). It is entirely probable that equally good results are to be secured with less disturbance by the use of sodium salicylate or the strontium salt in the same dosage. Not less than ten grains (0.6 gm.) should be given every two hours, and the same amount of sodium bicarbonate may be simultaneously administered, or given in the intermediate periods. The patient should receive not less than two drams (8.0 gm.) daily during the acute stage of his illness. If the stomach be irritable, and it seems undesirable to substitute another drug, clysma may be used, in which cases the dose should be doubled or increased at least one-half. With the generous list of drugs available this is seldom or never necessary. If, however, this method be adopted, care should be taken to employ 60 or 80 c. c. (3ii to iii) of water as a diluent, and to introduce the dose high in the bowel.

[Sodium salicylate may be given in very large doses by the bowel, suspended in starch—as much as 300 grains in one dose having been given. I have a fear of such large doses, and ordinarily so large a dose is not necessary. In some cases the toxic effects of the drug are produced by normal doses.—Editor.]

SALICIN.—Salicin is highly valued by many excellent authorities. In the writer's hands it has proven weaker and less certain in its action than the other preparations. Burney Yeo recommends it strongly in doses of from 15-30 grs. (1.0-2.0 gms.) every two or three hours, combined with one-half the amount of sodium citrate.

SALOL.—Salol in large doses, i. e., 15 grains (1.0 gm.) six or eight times daily, is sometimes useful, especially if the stomach be irritable, but it is far less efficient than are the salicylates themselves.

SALIPYRIN.—Salipyrin is another preparation, tasteless and unirritating, and of decided value as an alternative drug where other remedies are not well borne. It is administered in doses of fifteen grains (1.0 gm.) four or even six times daily.

Aspirin.—For the prompt relief of pain and amelioration of the general symptoms of the disease the writer knows of no remedy more certain or efficient than aspirin, unless it is antipyrin.

It is given in doses of fifteen grains (1.0 gm.) from four to six times a day in powder or capsules, and, if water or milk be taken freely at the time of administration, is quite unlikely to produce any irritating effects.

Antipyrin.—Antipyrin is a remedy of great value and extraordinary potency in most cases of acute rheumatism, but needs to be carefully watched on account of its depressant effects, though in this respect it would seem to be far less dangerous than acetanilid. In doses of ten grains (0.6 gm.) four times a day it is often extremely efficient, and may be given in five-grain (0.3 gm.) capsules or in peppermint water.

The reduction of pain under either antipyrin or acetanilid is rapid, and in most instances rheumatic patients seem to have a special tolerance for the former drug. The writer has used it for many years and found but few cases which did not promptly and satisfactorily respond.

Some of our foreign confrères maintain that it is of especial value in giving protection to the heart, but if this be true it must be chiefly because of the rapidity of its beneficial effects and the consequent prompt delivery of the patient from the threat of a profound toxemia.

Strychnia.—It is a wise plan to use moderate doses of strychnia of severe rheumatism, even though they are under rheumatic treatment.

Acetanilid.—Acetanilid is also efficient in no way superior to antipyrin.

Phenacetin (*Acetphenitidin*).—Phenacetin, in doses of from $7\frac{1}{2}$ to 15 grs. (0.5-1.0 gm.) three or four times daily, often serves an excellent purpose. It is unirritating to the stomach, but slightly depressant and markedly relieves the pain and reduces the fever.

Nearly all of the preparations named and especially the salicylates may produce nausea and gastric distress. The salicylates also tend to cause tinnitus aurium, in some cases vertigo, and in most an increase of the sweats. The coincident administration of an alkali will usually prevent the more serious of these manifestations.

Among other symptoms ascribed to them may be mentioned excessive nervous irritability, delirium, and a form of dyspnea characterized by excessively slow, deep respirations.

Hemorrhage from the nose, throat, and intestines has been reported, but these, like the symptom of albuminuria or true nephritis, seem less to be ascribed to the medicines used than the original toxemia associated with the disease. It is hardly necessary to state that the appearance of any marked or important symptom of overdosage demands a reduction of dosage or the use of another remedy.

The use of antipyrin is occasionally accompanied by rashes of the morbilliform or scarlatiniform variety.

OTHER FORMS OF TREATMENT

Vaccines and Sera.—These have been tried, but the results so far have been unsatisfactory or inconclusive.

The Alkaline Treatment.—This, as an independent primary method, is practically obsolete, and, as such, has never rested upon any substantial basis.

[It sometimes acts when everything else fails. As following the original salicylic treatment, it is valuable in the prevention of relapses. In order to obtain the best results the urine must be made alkaline.—Editor.]

Sodium Citrate or Bicarbonate.—It is well to use sodium citrate or bicarbonate freely in connection with other remedies, but these substances possess no specific antirheumatic qualities whatsoever.

TREATMENT DURING CONVALESCENCE

First: Avoid the resumption of active exercise for at least six weeks after the acute symptoms of any severe attack have subsided, and insist upon rest in bed for four of them.

Second: Examine the heart, both as to sounds and outline, with the utmost care and at frequent intervals during this period, and at longer intervals for months thereafter.

Third: Pay especial heed to subjective symptoms, such as pain, easily induced fatigue, precordial oppression, and dyspnea.

Fourth: At the earliest opportunity secure the removal of diseased tonsils and the efficient treatment of suppurating or chronically diseased sinuses, carious teeth, pyorrhœa alveolaris (Riggs' disease), and like sources of infection.

Fifth: Do not fail to treat vigorously and persistently the almost invariable anemia.

Sixth: Use every possible measure to maintain or improve the patient's nutrition.

SYMPTOMATIC TREATMENT

Hyperpyretic Cases

In the cases of hyperpyrexia, in which there is usually a sudden rise of temperature, running to 107-8°, or even 112° F., as in a case reported by Edwards, the patient's condition at once becomes critical, and, in the absence of prompt and radical treatment, the death rate is extraordinarily high. Such cases are likely to become stuporous, delirious, or actually comatose, combining the symptoms of the hyperpyretic complication with those of so-called "cerebral rheumatism," though this latter is still separately referred to as a special form in which apoplectic accidents occur.

The proper treatment consists in immediate recourse to cold baths exactly as these would be applied in typhoid fever, and an immediate resort to stimulants to anticipate or combat the cardiac weakness which generally accompanies the condition. It is said that under such treatment more than one-half of these cases recover.

Insomnia

This is often a persistent and troublesome symptom long after the active symptoms have abated.

Resort to the bromids, veronal, and other such remedies may be absolutely necessary, but fresh air in the sleeping room, iron, good feeding, hot drinks, or, better still, a light hot feeding at bedtime and a mild course of cardiac stimulation will often work wonders.

Treatment of Cardiac Complications

The management of endocarditis, pericarditis, and myocarditis, or pancarditis, occurring during the course of acute rheumatism, differs in no material respect from the same lesions as encountered under other conditions.

The icebag is one of the best agents for reducing pain if present, relieving the oppression so commonly experienced in connection with the development of all three of these lesions, and cardiac stimulation may be

resorted to when necessary, though seldom very useful in any one of the cardiac complications in their earlier stages.

On the other hand, absolute rest is of the utmost importance, and in this connection it may again be stated that too much emphasis cannot be given to the necessity for such rest, not only in the presence of cardiac lesions, but during and for some weeks after a severe attack of inflammatory rheumatism.

It should be remembered that the myocardium is always more or less affected, that an endocarditis may exist before a murmur becomes audible, and that even a severe myocarditis may be extremely obscure and lack all frank symptoms.

The writer firmly believes that practically every case of severe acute rheumatism involves the heart muscle to a greater or less extent, although in the case of both muscle and valves the effects may be only temporary. He further believes that, in respect to the myocardium especially, the ultimate result depends largely upon the treatment which these victims receive, not only during the acute attack but after it, and that rest and generous but judicious feeding in convalescence play an all-important part in this connection. In the past the tendency has been to underfeed such patients and allow them to leave their beds and resume active exercise far too soon.

In the case of this, as with so many other infectious diseases, notably influenza, far too little care is taken to protect a heart muscle thoroughly poisoned by the toxins of disease, and to watch over it during convalescence. Again and again one sees cases in which cardiac oppression or pain has never been absent since the original attack, and one cannot but feel that the issue would have been more favorable had the physician in charge of the case been more insistent upon prolonged rest.

The greatest care is necessary both during and after an attack in respect to the avoidance of exertion. A rapid pulse, irregularity, precordial oppression, subjective fatigue, blurring or reduplication of heart sounds, and especially any marked increase in the cardiac outline should be considered quite as important as murmurs so far as they relate to treatment.

Acute pericarditis developing during rheumatism may demand an opiate, but is remarkably responsive to antirheumatic remedies.

If heart weakness appears, and at whatever the period, cardiac stimulation is indicated even though it prove inefficient. On the other hand, no attempt should be made to drive a heart simply because a murmur is present. At all times we are treating heart muscle weakness and not a murmur or vegetation merely.

The Anemia of Acute Rheumatism

There are few diseases in which anemia is more rapidly produced, and attention should always be paid to this feature during the period of con-

valescence. The degree of anemia and the type are about the same as that encountered in a case of long-established, moderate chlorosis or an early secondary anemia, and the condition rapidly disappears under the use of generous tonics and good food. It is seldom of high grade, but if untreated it unquestionably predisposes the patients to recurrent attacks, and constitutes an added source of danger in connection with the circulation.

Meningitis

Cases of meningitis have been reported which were believed to be of rheumatic origin, and in any event developed in connection with and during an acute attack. It is a rare complication, and when it exists is apparently unrelieved by antirheumatic treatment and subject to the same therapeutic management as other forms of meningitis.

Neuralgia

Persistent neuralgias appear in connection with, or more often following, acute rheumatism, and are, as a rule, very markedly improved by the salicylates, and still more so by aspirin, antipyrin, or phenacetin. In many instances these neuralgias, though at first presumably due to the toxins of the primary disease, are perpetuated by unrecognized or untreated anemia, or represent the persistence of disease in the accessory sinuses.

Chorea

There can be little doubt as to the connection between cases of chorea and rheumatism, or, at least, between chorea and those organisms representing the cause of the chronic focal infections now believed by many to be responsible for the development of rheumatism itself.

The statistics concerning the prevalence of the condition differ somewhat widely and correct figures are probably unattainable because of the tendency of the disease to develop in childhood, when rheumatic manifestations are diverse and atypical, exceptionally mild for the most part, and in many instances entirely overlooked.

In Osler's series but 15.8 per cent. of his choreic cases gave a definite history of antecedent articular swelling, either acute or subacute, but in thirty-three cases there had been pains sufficiently marked to be entered in the history. These raised the percentage to nearly twenty-one, which closely corresponds to his Johns Hopkins series, which showed a percentage of 21.6 per cent.

Unfortunately, we do not possess sufficiently full and accurate statistics at the present time concerning antecedent inflammations of the throat,

the presence of adenoids, and inflammations of the accessory sinuses to furnish proper ground for a positive assumption that the connection between chorea and these infections of the throat and nose is the same as that observed in the case of acute rheumatism itself. Much proof has been presented, however, and this opinion is constantly gaining ground.

It will be remembered that in chorea over 70 per cent. of the cases occur in the female, and that in children the predominance of acute rheumatism in the female is a striking feature.

The remarkable incidence of endocarditis in connection with chorea is also suggestive in relation to its connection with rheumatism, and yet more so, perhaps, in relation to antecedent infections of the nose and throat. In Osler's study of the literature he found seventy-three autopsy records in choreic cases, and but twelve of the subjects were free from endocarditis. The form of endocarditis is almost always simple, and pericarditis is seldom seen in the absence of active rheumatic symptoms.

The treatment of chorea as a complication or sequel of rheumatism does not differ materially from that prescribed under other conditions. It is often strikingly benefited by the antirheumatic remedies, and it would seem that in the future more attention should be given to the removal of any possible source of chronic focal infection.

A number of interesting reports have appeared relating to the prompt relief of chorea after tonsillectomy and operations have been performed even during the attacks with apparent success.

Acute Scarlatinal Arthritis (Scarlatinal Rheumatism)

Incidence.—The disease appears most frequently as a complication of the exfoliative stage of scarlet fever.

It is usually polyarticular and in most cases begins in the hands rather than in the feet or ankles. The fever is usually of moderate degree and the joint symptoms are relatively mild and peculiarly fleeting, though the disease may be prolonged by the involvement of previously unaffected joints. Pain and swelling are less severe than in well-developed primary rheumatic fever, and the entire process usually lasts but a few days.

Its incidence depends apparently upon epidemic variations, but it is certainly a relatively rare condition, if one considers the total number of cases observed over a period of years.

[Still rarer is the pyemic form, of which I have seen three cases.—Editor.]

Treatment.—No drug exerts a specific influence. Aspirin, salipyrin, or the salicylates proper are usually given with varying effect. Full doses of quinin have been highly recommended.

[The pyemic form is treated as a septicopyemia. Locally collections of pus should be evacuated as early as possible.—Editor.]

Syphilitic Arthritis (Syphilitic Rheumatism)

Luetic arthritis may be monarticular or polyarticular. The acute form usually involves several joints, whereas the subacute type is more often limited to one. More than three joints are seldom affected in either form.

A remittent fever is usually observed, and the objective symptoms may or may not be well defined.

Pain is moderate as a rule, and the ailment responds promptly to anti-luetic remedies.

Acute joint symptoms occur usually at the time of the appearance of the secondary eruption, but may be associated with the earlier tertiary period.

Treatment.—Usually the iodids promptly remove all symptoms. Salvarsan may also be employed. Local applications of mercury ointment are recommended with massage and temporary, partial, or complete immobilization. If not correctly diagnosticated and appropriately treated, even the acute form may persist for many weeks.

Gonococcic Arthritis (Gonorrheal Rheumatism—Gonorrheal Arthritis)

This disease is ordinarily associated with an active urethral or vaginal discharge, due to the gonococcus of Neisser. If subsequent attacks occur, as is not uncommon, this specific organism may be lacking in any gleety or purulent discharge present at the time. Murrell and Hicks have reported the recovery of a diphtheria-like bacillus in gleety discharges lacking gonococci and report the cure of certain of these cases with autogenous vaccines.

The ailment may result from infection of any mucous membrane, and it would seem that previous attacks of rheumatism, strains, and joint injuries act as factors of predisposition and localization. It was formerly thought that this form of arthritis was largely confined to the male sex, but it would seem that in the light afforded by modern bacteriologic methods the disease will prove to be about equally prevalent in the two sexes. It is by no means uncommon in children, and is readily disseminated in institutions. Murrell states that as seen in children the disease is usually polyarticular and may affect both the small and large joints.

In 75 per cent. of the cases the knee joint is primarily affected, and there is usually no inflammation or pus formation. The joint or joints affected may be either very painful or but slightly so. It comes on usually during the third or fourth week of the disease, but may occur within ten days of infection, or be postponed for some time after all purulent urethral discharge has ceased.

Its onset is seldom abrupt and is usually unattended by chill or high fever, though the temperature may be elevated one or two degrees.

Its duration varies from a few days to several months, but chronicity is the rule, and marked deformity and considerable disuse or atrophy may result.

One joint only is chiefly or alone involved in most cases, but it may be polyarticular and involve the shoulder, hip, wrist, hands, feet, or, indeed, the temporomaxillary, sacroiliac, or sternoclavicular articulation.

In polyarticular gonorrheal arthritis the case may strongly resemble acute rheumatism, save that the joint symptoms are strikingly persisting, rather than shifting and fleeting in character. There is less redness of the skin, and the joint swelling and pain do not markedly respond to salicylates. In all such cases every joint should be tested for pressure-tenderness, which is frequently present in most unexpected and unusual situations without outward and visible signs of inflammation. There may also be tenderness in the muscles and aponeuroses.

Heart complications are uncommon, but may occur, and gonococci be recovered after death from vegetations, or, during life, from the exudates and blood. Such attempts may fail, however, and make the diagnosis dependent upon existing or recent urethral infection and lack of response to the salicylates and to mercury.

Treatment.—The urethritis must be cured by appropriate methods. Strictures must be relieved, and the patient himself and the affected joint or joints be put at rest.

Absolute fixation for more than a few days at a time is unwise by reason of the readiness with which adhesions form in such cases.

BIER'S METHOD.—In a recent article by Bier and Baetzner it is claimed that the "hyperemia method" of the former is especially effective in gonorrheal rheumatism, however severe its type. The general technique is thus described:

"For the production of passive hyperemia it is best to use a thin rubber bandage, about 6 cm. in width, and from 1½ to 2½ m. in length. This is applied as smoothly as possible round the limb to be treated, in several turns, one over the other, to form a broad girdle near the trunk. There is no need for a pad underneath. For use on the thigh a more substantial bandage is used; while for the shoulder are used lengths of soft rubber drainage tube, about the thickness of the finger, covered with felt up to each end. This inclosed tube is applied, well stretched round the affected shoulder from the axilla, and fixed as a ring by means of a pressure forceps, which can be replaced by a knotted turn of bandage. This ring of tube is then stretched well toward the middle line over the affected shoulder, and kept from slipping by means of a girdle, passed round the thorax before and behind, and fastened together under the healthy axilla. Over prominent parts of bones, especially over the exposed clavicle, and

also in the axilla, careful padding with cotton-wool is necessary. Throughout the duration of the congestion careful attention must be paid to the skin at the site of constriction. This is best done with spirits of camphor and zinc-powder. Eczematous and other lesions are thus avoided. The degree of reaction resulting from the congestion differs according to the acuteness of the disease and the patient's capacity for reaction. The most complete result is shown by intense exacerbation of all the inflammatory symptoms, by great swelling, and by a vivid, hot, and fiery reddening, which extends over the whole limb as far as the bandage. In some cases only a uniformly warm swelling is observed, without any special increase in the inflammatory redness. In other cases, again, only a moderate swelling, pale and whitish, is obtained.

"As regards the proper degree of congestion two conditions are particularly essential. The congested limb must feel warm. Cold limbs are not hyperemic, but rather anemic, so that the object of the congestion entirely fails. Then, again, there must be complete absence of pain. The correct technique provides for a period of congestion lasting from 20 to 22 hours each day. During the interval of rest most of the edema set up is absorbed, the limb being kept well raised. Should the actual acute inflammation have ceased, then the hot-air bath comes properly into play, the object now being to resolve the old infiltrations, adhesions, and stiffnesses. For hot-air treatment use is made of the simple wooden boxes, designed by Bier, which are lined with asbestos, and are heated by a gas or spirit flame through a flue. Treatment for half an hour at a temperature of about 100° C. is the most suitable."

Treatment by antogenous or stock vaccines has been highly recommended, but has not so far been proven of great value.

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CHAPTER XVIII

ACUTE BACILLARY DYSENTERY

CHARLES WARREN DUVAL AND ISAAC IVAN LEMANN

GENERAL INTRODUCTION

The name dysentery is primarily a clinical term, and is applied to several conditions of the intestinal tract that are characterized by tenesmus, mucous and bloody stools, and mild or severe toxic symptoms. The classification of the dysenteries is still confusing in spite of the generally accepted division into amebic and bacillary. Clinically we recognize acute and chronic forms of the disease. Epidemiologically we speak of sporadic, endemic, and epidemic dysentery, while etiologically we recognize bacillary, amebic, and still other forms due to animal parasites. As this chapter has only to do with the dysenteries caused by a specific bacterium we will confine our remarks entirely to this phase of the subject.

Definition.—Bacillary dysentery is an acute infectious disease caused by a specific bacillus, and characterized by an acute inflammatory process of the intestinal mucous membrane, more especially that of the large gut. The disease may be divided into (1) the epidemic form which is caused by the true Shiga bacillus and (2) the sporadic or endemic type which is due to some one of the para-dysentery bacilli.

Although bacillary dysentery is an extremely prevalent disease, occurring in epidemic form in the tropical and temperate zones and appearing endemically throughout the world, its etiology was obscure until 1898 when Shiga determined, with scientific accuracy, the causal agent in the acute epidemic variety. The etiological importance of Shiga's discovery has been thoroughly exemplified by many investigators in all parts of the civilized world. Flexner and his co-workers are largely responsible for our present knowledge of the etiology of bacillary dysentery other than the epidemic form. The investigations of Duval and Bassett in the summer of 1902 demonstrated an etiological relationship between a specific bacillus (para-dysentery) and infantile summer diarrhea.

Since the determination of the causal agent in the various forms of acute dysenteries has an important bearing upon serum or vaccine treat-

ment it is well to discuss briefly this question of varieties of the dysentery organism, and state in the opinion of the writers their possible significance. Although many varieties of dysentery bacilli have been described and regarded by those reporting them as strains of the same species, the status to-day is that acute specific dysentery is caused by two distinct bacterial species. In 1903 it was established that two distinct types of bacilli occur in dysenteric stools, the true Shiga type and the type that ferments mannit, which has subsequently become known as the Flexner stem or para-dysentery bacillus, of which there are a number of strains. The Shiga bacillus is responsible for the epidemic dysentery and the Flexner stem for endemic and sporadic dysentery.

Kruse was the first to show that the dysentery bacillus of Flexner and that isolated from the asylum dysenteries, though alike in respect to each other, differed in agglutinability and pathogenicity from the Shiga bacillus of epidemic dysentery and therefore constituted a distinct species. Subsequently many investigators have not only confirmed this distinction, but have established other important and constant differences, which further separate the Shiga and Flexner bacilli. It is noteworthy that the Shiga bacillus is rarely met with outside of epidemics, while the para-dysentery group of which the Flexner bacillus is representative is of widespread distribution and possibly a normal inhabitant of the intestinal tract (Duval). This would account for the fact that the Flexner bacillus occurs in the stools of the epidemic dysentery, and in a large percentage of cases as the epidemic wanes, playing the rôle of a secondary invader.

Terminal dysentery is a frequent occurrence in a great number of diseases, and in the experience of the writers it is the Flexner organism that occupies the clinical field at death. In hundreds of such cases examined bacteriologically by one of us (Duval) the Shiga bacillus has not been encountered. Consequently, we can state that the Shiga bacillus is rarely met with in sporadic cases of dysentery, and never plays the rôle of terminal invader. Furthermore, in addition to distinct cultural and agglutinating differences, Flexner and Sweet have shown that the Shiga bacillus produces a soluble toxin while the toxic substance of the Flexner organism is intimately bound up in the bacterial cell. While many American observers are generally inclined to consider the Shiga and Flexner organisms of similar etiological importance, the Germans, who regard the difference between the organisms as significant, consider the Shiga type as the only one which has a causal relationship to acute epidemic dysentery. That the two organisms both produce acute inflammation of the gut characterized by the same general symptom-complex is no reason for thinking that they are not different species since the various intestinal organisms all closely resemble one another. Thus the typhoid and paratyphoid bacilli are distinguished by methods not more

definite than those differentiating the Shiga and Flexner bacilli. On the basis of so many essential distinctions, and in spite of the similarity in morphology and cultural properties, we may conclude that the bacillus of sporadic, endemic, institutional dysentery and the summer diarrheas of infants (the para-dysentery group or mannit fermenters) is not related biologically to the Shiga organism.

Pathology.—The essential lesion of bacillary dysentery is in the intestinal tract, almost invariably of the large gut, and primarily at the various flexures. In severe cases the lower portion of the ileum, together with the large intestine, is the seat of pathological change. Occasionally the lesions have been noted throughout the whole of the small intestines, extending as far as the pyloric orifice.

In general the mucosa and submucosa of the intestine are swollen, edematous, and dark red in color, and not infrequently covered entirely or in part with a fibrinous exudate (pseudo-diphtheritic membrane). Blood-streaked mucus may be found in considerable quantities associated with the exudate or in the gut content. There may be, however, an absence of membrane, the mucosa showing merely discrete and confluent ulcers or shallow erosions, which rarely extend below the muscularis mucosa. Fatal acute hemorrhage is exceedingly rare and perforation of the gut with peritonitis is almost unknown in uncomplicated cases of bacillary dysentery. One of us (Duval) has seen a case where the dysenteric ulcer perforated and gave rise to a fatal peritonitis. This was a sporadic case of dysentery due to the Flexner bacillus which occurred at the Touro Infirmary in 1911.

The mesenteric lymph nodes are occasionally enlarged, due presumably to the absorption of the specific toxin, or, what is more likely, the result of invasion of other microorganisms from the intestinal tract. It is noteworthy in this connection that *B. dysenteriae* has never been recovered in pure culture from the enlarged mesenteric glands. In these cases the specific organism is always associated with colon bacilli and other allied species.

Bacillary dysentery, unlike typhoid, does not give rise to a bacteriemia; the organism remains throughout the course of the disease at the site of the initial lesion. It may enter the circulation from time to time, but is quickly killed out, proof of which are the negative blood culture findings. Recently, however, Darling reports a fatal case of bacillary dysentery in which the Flexner type of organism was recovered in blood culture before death.

Multiple miliary abscesses of the liver occasionally are found at autopsy, but in the few cases reported the specific organism in this situation has occurred along with *B. coli* and other intestinal bacteria. With the exception of the degenerative changes in the internal organs extraintestinal lesions are unknown in bacillary dysentery.

PROPHYLAXIS

Geographical.—Epidemics of bacillary dysentery have occurred from the earliest times throughout the tropics and temperate zones. At the present time epidemics are infrequent compared with the days before modern sanitation. However, small circumscribed epidemics break out occasionally in the congested districts of large cities. On the other hand, endemic dysentery is a common occurrence in asylums and public institutions. That form of the disease known as infantile diarrhea is prevalent in all large cities during the summer months. Indigenous dysentery is therefore of more importance nowadays than the epidemic form. In the tropics and temperate zones one form or another of bacillary dysentery is always to be found. In general it may be said that wherever the hygienic conditions are bad, especially if the water supply is polluted with human excreta, dysentery is endemic and may become epidemic.

Epidemiology.—Outbreaks of dysentery in a locality have been attributed to other factors than the water supply; this is not because of any peculiarity of the soil or climate, but because new foci of infection are continually occurring. In recent years many of the most obscure facts concerning the dissemination of dysentery have been elucidated by the discovery of the intimate relation borne by dysentery patients and convalescents to the further spread of the disease. Dysentery bacilli always leave the body by way of the excreta, pass into the external world, and find their way into others indirectly through water.

Almost all large epidemics of dysentery are water-borne infections, mainly because of the too intimate connection between sewage disposal and water supply. There is the same epidemiological relation of the two in this disease as in typhoid fever, since the causal agent in both diseases leaves the body in the feces. Polluted well water is a common source of infection in country districts.

Dairy products and other foodstuffs which are consumed in the raw state may be important sources of infection, because infection invariably takes place by the ingestion of the bacteria in infected water or food contaminated by the feces of dysentery patients. Some epidemics of dysentery can be traced to infected milk which has been polluted by water used for the purpose of cleansing the cans or utensils employed for its transportation. Milk is undoubtedly an important factor in the spread of endemic dysentery, especially that in children.

Epidemics of more or less definite localization usually occur under conditions of crowded quarters in unsanitary environment.

The common house fly plays an important rôle as a mechanical carrier of the disease. This insect is especially concerned in the spread of endemic dysentery which is so prevalent among infants of congested city

districts during the summer months. Cases formerly attributed to dust may be reasonably ascribed to this insect. Furthermore, with infant dysentery the infecting agent may be transported directly from the infected to the healthy in the same or adjoining wards of a hospital through the medium of nurse or attendant. The slightest soiling of the hands with fecal material may be the means of spreading the disease. The stool from a case of dysentery should be as carefully disposed of as the dejecta from typhoid patients.

Bacilli Carriers.—We see no reason to doubt that the individuals who have recovered from acute dysentery may not harbor for months *B. dysenteriae* in their intestinal tract. Since the Flexner organism may be a normal inhabitant of the gut (under ordinary circumstances an innocent one), and since it is conceivable that even the Shiga bacillus may persist in small numbers months after an acute attack, human beings, themselves apparently well, may serve as “carriers.” Such “carriers” are, however, not entirely analogous to those of typhoid fever, for in the latter instance the gall bladder becomes infected and serves as a lasting bacterial reservoir. They are, on the other hand, just as important as “typhoid carriers.”

Agglutination Reaction.—The recognition of the type of infecting organism in every case of bacillary dysentery is of the utmost importance from the standpoint of treatment with an immune serum. Where such treatment is contemplated it is essential as a matter of routine to determine in every case by the agglutination reaction the type of the organism.

Sera from patients suffering from bacillary dysentery, whether epidemic or endemic, agglutinate the specific organism. Therefore it may be said that the agglutination test in this disease has the same, if not greater, diagnostic value as the Widal reaction has in typhoid. Bacteriolysins and other immune substances also appear in the blood of patients suffering with dysentery. The agglutinins are readily demonstrable on the third to the fifth day after the onset of symptoms. The blood from animals artificially immunized against the Shiga bacillus will agglutinate para-dysentery bacilli, though not in as great a dilution as it will the Shiga organism. The converse is also true. Since the para-dysentery organism may occur normally in the intestine, its mere presence in the feces of a dysenteric patient is no proof of its causal relationship to the disease. If, however, along with the demonstration of the organism in the bowel discharge, the serum from the patient causes clumping of the bacillus in dilutions 1 to 50 or higher, the infection may be pronounced dysentery due to that particular organism.

The isolation of the organism from the stool of a suspected case as a means of diagnosis is often disappointing even in the hands of the experienced laboratory worker. It requires at least forty-eight hours to determine the culture from the most favorable stool specimen, and often

repeated examinations of a number of stools; so that the cultural method of diagnosis is of limited usefulness, except in conjunction with some one of the serum tests. However, in epidemics of dysentery which are due to the Shiga organism the cultural method is of more importance than in endemic dysentery.

The precipitin and absorption tests for the differentiation of *B. dysenteriae* are specific, but are not practical outside of the scientific laboratory.

The cutaneous reaction in the diagnosis of dysentery need only be mentioned, as it is of the least value of all of the serum tests. Though it will serve to diagnose dysentery from other intestinal diseases, it will not differentiate the type of organism, that is, whether the disease is due to the Shiga or some one of the para-dysentery bacilli. The material used in this test is prepared and administered in the same way as tuberculin.

TREATMENT

SERUM TREATMENT

Shiga was the first to prepare and use successfully an immune serum for the treatment of acute epidemic dysentery. For endemic dysentery, or that form due to some one of the para-dysentery group, he employed a polyvalent serum and claims to have reduced the mortality in Japan from 35 per cent. to 9 per cent. That decided improvement follows its use in epidemics among adults there is no question. The conditions of success are that it must be used early in the disease before serious lesions have developed or a secondary infection has set in, which is a common occurrence in acute dysentery. Furthermore, to obtain the best results the serum must be used in large doses and often repeated. It is the rule to give a dose twice daily and continue over several days if the attack is severe. Of the serum product now on the market at least 30 c. c. should be given at a dose in the case of an adult and 15 c. c. for an infant.

It is important to determine the type of infection before giving the serum in order to know what serum to give. Though a polyvalent serum is advocated in all cases regardless of the type of infecting organism, it is far better to give only the serum specifically suited in the individual case. For example, the "Shiga" serum in the treatment of endemic dysentery due to the para-dysentery bacillus (Flexner) is of no avail, and conversely. Acute dysentery is probably a true toxemia, its symptoms being referable almost entirely to the absorption of the specific toxin. Intravenous injection of the Shiga toxin will cause a violent diarrhea and intestinal lesions in the rabbit, but these results are not obtained with the injection of the toxic product from the para-dysentery group of bacilli.

The intestinal lesions are definitely shown experimentally to be due to the excretion of the toxin, and not due to the direct action of the bacilli upon the gut mucosa. This has been proven for the Shiga organism, but not for the para-dysentery group, which might explain why in endemic dysentery the serum treatment is not so efficacious.

In the natural course of the disease antitoxin is formed; it is, therefore, obvious that an immune serum which is an antitoxin is advocated in the treatment of acute bacillary dysentery. Passive immunization is most effective in the epidemic form of the disease. Here the patient shows a distinct benefit, and there is a marked reduction in the mortality by the use of the immune horse serum. Some authorities claim that after a single injection of 15 c. c. the temperature has dropped to normal, the character and frequency of the stool changed, and the patients made an uninterrupted recovery. The beneficial result of an immune serum is due to its antitoxin content and not due, as formerly thought, to its bactericidal property.

In the endemic dysentery the serum has not been as promising, especially in the form known as infantile diarrhea. The beneficial results here are obtained in the acute attacks where there are symptoms of severe intoxication. In cases where the powers of resistance have been lowered and the nutrition impaired serum therapy is apparently of no avail. In these cases the real problem is not one of specific infection. The symptoms are, in most instances, due to secondary infection, if infection at all, and are related to impaired digestion and not to a specific toxemia.

In endemic dysentery a polyvalent serum is indicated—that is, a serum in which the various para-dysentery bacilli have been employed in the active immunization of the horse, since these organisms are subvarieties of the same species, and it is not practical to determine the particular subgroup responsible in a given case.

Vaccination.—Prophylactic vaccination for acute epidemic bacillary dysentery leads to practical results. Since it will protect the individual against subsequent infection for a period of eight to ten weeks its usefulness is apparent in preventing the spread of the disease in outbreaks of epidemics in asylums, institutions, camps, etc. Vaccination against dysentery has the same practical value in this disease as it has in typhoid. Active immunization in this manner should be insisted upon for nurse, attendant, and all persons associated or likely to come in contact with those suffering from the acute epidemic type of the disease.

The dysentery “vaccine” may be prepared after any of the standard methods. Virulent cultures of the specific organisms are first grown upon slanted nutrient agar for twenty-four hours, when the growth is washed down and thoroughly emulsified in sterile normal salt solution. The suspended culture is then killed by heating at 56° C. for thirty min-

utes, or it is carbolized in 1 per cent. carbolic acid solution for twenty-four hours, after which it is standardized and tested for viability. The dose of the killed culture (vaccine) is given hypodermatically and varies from 500,000 to 1,000,000 bacilli or more. In administering the "vaccine" as a prophylactic it is well to repeat the injection in two or three days, using double the amount of the initial dose. A local subcutaneous reaction at the site of inoculation usually follows in twenty-four to thirty-six hours and may be looked upon as a favorable sign. In some instances the injection occasions constitutional symptoms with one to two degrees of fever. It may be stated that the more marked the reaction, both local and constitutional, the more effective and lasting is the acquired immunity. While vaccine therapy is recommended as a preventive in acute epidemic dysentery (Shiga) under the conditions above mentioned, its promiscuous use is not advocated, since it is impracticable. This has reference to its use as a preventive against the spread of endemic or sporadic dysentery.

Statistics show that vaccination as a curative agent for dysentery has not given brilliant results. This might be due in part to the use of a "stock" vaccine where a "personal" or autogenous culture should have been employed. Where the specific organism can be isolated the vaccine should be prepared from it and not from stock culture if the best results are to be obtained.

Theoretically, in the so-called chronic form of endemic bacillary dysentery, where the specific organism (para-dysentery bacilli) still lurks in the deeper layers of the gut, the use of a polyvalent vaccine (prepared from the various strains of para-dysentery bacilli) is indicated. However, in the large percentage of these cases, the initial excitant has disappeared and the intestinal condition is prolonged by some one or more of the normal inhabitants of the intestine, such as the streptococcus, pneumococcus, and staphylococcus. Therefore, it seems more reasonable to employ a "vaccine" specific for these organisms and not one calculated only to be of use against the primary causal factor.

TREATMENT OTHER THAN SPECIFIC

Treatment of Dysentery in Adults

What is here written applies to all forms of bacillary dysentery of whatever group. The symptomatology and general course of the disease are the same whether the infecting organism be of the Shiga or the para-dysentery type (Flexner). Hence the treatment of the epidemic (Shiga) dysentery is the same as that of the endemic (sporadic) and institutional dysenteries. At the outset, it is to be remembered that we have to deal practically with two consecutive conditions, namely, the

acute infectious disease which is more or less self-limited and the sequelæ of this acute infection. For we must regard the long-protracted diarrheal conditions not as a continuance of the disease itself, but as a true sequela, separate and distinct anatomically and bacteriologically from the initial disease.

Treatment of Acute Stage.—A patient with acute bacillary dysentery should be treated in many ways like one with typhoid fever. As in the latter disease, so in bacillary dysentery, nursing is of prime importance, not only to the patient himself but to his immediate environment and to the community at large. (See under Prophylaxis.) Absolute rest in bed is essential in all cases, for physical exertion otherwise incidental to the numerous bowel evacuations add to the prostration caused by the toxemia and the pain. It is strange to see dysentery patients (even severe cases) permitted to alternate constantly between bed and commode, and that, too, by physicians who would be scandalized by the thought of permitting this in mild typhoid cases. The arrangement of the bed is of considerable importance. It should, if possible, be of the usual hospital type, a single narrow bed, fairly high, as this will permit the easy handling of the patient and the convenient adjustment and removal of the bedpan without unnecessary exertion on the part of the patient or nurse. In this way, too, will be avoided any accidental spilling of bedpan contents and contamination of bed and personal linen probable under more awkward and inconvenient arrangements. The mattress should be protected by a rubber sheet, and over this should be placed sheet and draw sheet. In many cases desire to go to stool is so frequent as to be practically constant, and in these cases the patients insist on having the bedpan under them for long periods at a time, so that the construction and form of the bedpan are more than ever of importance in that it should be as comfortable and cause as little trouble as possible by pressure. (It must be conceded in this connection that there are patients who insist on using the commode on account of the annoyance of the bedpan, and will not consent to remain in bed until forced to do so by their own prostration and weakness.) Scrupulous cleanliness of the patient must be insisted upon, care being taken upon this point not only after each use of the bedpan, but also by the usual daily general cleansing bath. Aside from this, it is not usually necessary to use baths except in cases with fever. In such cases cool, gentle sponging or towel-ing of the trunk and limbs and the ice cap applied to the head are the most satisfactory forms of hydrotherapy.

Hot-water bags or large poultices to the abdomen add greatly to the patient's comfort.

FEEDING.—Here the limitations are narrow and the problem presented by the indications and contraindications is a puzzling one. Physiological rest for the damaged organ would seem to be our first considera-

tion. In the beginning the wisest course is total abstinence from food leaving a residue. In this category milk must, of course, be included. Milk however administered, whether raw or boiled, must be considered only a quasi-liquid food. In the stomach the casein is immediately precipitated, and the food is henceforth a solid, and likely to set up peristalsis upon entering the intestine. An additional objection to milk is that it furnishes a fine culture medium for the intestinal flora. The pediatricists have long since seen the wisdom of immediately withdrawing milk upon the slightest bowel disturbance. It is a lesson we should learn to apply in the treatment of adults. On the other hand, in the face of the toxemia and the excessive loss of fluids, we must not, in our zeal to protect the intestine from injurious influences, carry on the starvation too far or too long, nor fail to supply fluids in quantities sufficient to countervail the excessive outgo. While we cannot supply anything like sufficient caloric values, still by the use of strong broths, albumen water, whey, barley water, as well as of alcohol in conjunction with extractives (in the form of the various proprietary so-called foods) we can furnish a valuable amount of stimulation as well as a small amount of the calories needed. In this connection it would seem that the suggestion of Kendall with regard to the use of lactose in infantile diarrheas would be of considerable value. There is no reason why we should not, by adding lactose to the various drinks, contribute largely to the sum total of calories furnished. In addition to this, if Kendall's reasoning is correct, we may, through the lactose, favorably affect the intestinal bacteria in the sense of giving the normal flora of gas-producing bacilli the upper hand over the bacillus dysenteriae and thereby directly influence the further course of the disease. The administration of water is of greatest importance in the acute stage. Patients may be persuaded to take and prefer water in the form of decoctions and infusions so as to do away with the flat taste. The tisanes of the French, such as orange leaf tea, bay leaf tea, geranium tea, are exceedingly grateful and pleasant. After some days of this meager diet, and when symptoms begin to ameliorate, it will be permissible to add milk, at first diluted and, perhaps, even predigested when necessary. Some authors claim that boiled or Pasteurized milk is better cared for than raw milk. Not until the patient has entirely recovered and has been without symptoms for a week at least should we venture to increase his dietary by the inclusion of soft foods (cereals, soft-boiled eggs, etc.). From then the return to the normal diet should be slow and gradual, meat, puréed vegetables (potatoes, carrots, etc.), and puréed fruits, being successively added. Not for weeks should the patient be allowed to eat raw fruits or bulky vegetable food. (Some writers permit a very much more liberal diet all through. Thus, Hewes outlines as a suitable dietary the following: 300 grams lean meat, 3 slices of toast, with maple syrup, albumen water, consisting of the whites of eight eggs.

This he gives for five days, then increases it by more toast, butter, tapioca, potato juice, rice, macaroni.)

DRUGS.—All unite that it is impossible to check the diarrhea at once by astringents and opiates, and unwise to attempt to do so. All equally unite in recommending a preliminary and thoroughgoing cleaning of the bowel by purgation. For this purpose some prefer castor oil, not only on account of its efficiency, but also because of the subsequent constipating effect attributed to it. It may be given in an initial dose of \mathfrak{z}_{ss} - \mathfrak{z}_i (15 to 30 c. c.), or in small repeated doses. Thus Meara, in a recent article, recommends the following, which he credits to Delafield:

R	Ol. ricin.	10	\mathfrak{z}_{iiss}
	Salol.	2.5	gr. xxxvii
	Tr. opii deodorat.	0.1	\mathfrak{m} iss
	M. et in cap. No. xv.		

Sig.—One every two hours.

Calomel may be given in one dose of five grains (0.3 gm.), or in broken doses of gr. 1-6-gr. 1-4 (0.01 gm. to 0.015 gm.) every half hour until stools become fecal. Magnesium (or sodium) sulphate has supporters equally as ardent as those of castor oil and calomel. There is no doubt as to its great value in the large majority of cases. It seems best to give at the outset one large dose, \mathfrak{z}_{ss} to \mathfrak{z}_i (15 to 30 grams), and to follow with smaller doses (\mathfrak{z}_i , 4 grams) every two to four hours. An excellent formula, which has done excellent service, is:

R	Magnesii sulphat.	(30.0)	\mathfrak{z}_i
	Tr. opii deodorat.	(8.0)	\mathfrak{z}_{ii}
	Ac. sulphuri. aromatic.	(8.0)	\mathfrak{z}_{ii}
	Aq. menth. pip. ad	(180.0)	\mathfrak{z}_{vi}

Sig.—Tablespoon every three hours.

Here the opium is given for the relief of pain. The sulphuric acid is said to be of value because of its astringent action. The prescription should be given until the stools cease to be bloody and become fecal in character.

Ipecac, while probably of greatest use in amebic dysentery, is said to have some value in bacillary dysentery. It should be used in the same manner as in amebic dysentery. One dose daily is given, beginning with 40 grains (2.75 grams) and decreasing by 5 grains (0.3 gm.) each day until a dosage of 5 grains (0.3 gm.) is reached. This last dosage is kept up for a week or ten days after the stools are normal. The ipecac may be administered in salol-coated pills (to prevent disintegration until they reach the intestines) or in a powder or bolus. Formerly the ipecac was preceded by laudanum (gtts. x to xv-1 c. c.) by about fifteen minutes, but since the introduction of salol-coated pills this is for the most part

unnecessary. The pills are given after a fast of three or four hours, and the patient is instructed to lie absolutely quiet on his back. Simaruba is another drug which has enjoyed considerable reputation as an anti-dysenteric; it like ipecac should probably be confined to use in amebic dysentery. It may be used as an infusion (50 grams in 75 c. c. of water) (Ortner) or it may be used in connection with magnesium sulphate.

In addition to these remedies by the mouth it may become necessary to use morphin by hypodermic injection for the relief of pain. The tenesmus is best treated by the rectal injection of 1 to 3 ounces (30-90 c. c.) of starch water to which has been added 15 to 20 drops (1 c. c.) of laudanum. When this does not succeed we may have recourse to suppositories of

R	Pulv. opii	gr. 1	0.065 Gm.
	Ext. belladonna	gr. $\frac{1}{4}$	0.015 "

Daily irrigations of the bowel with large quantities of salt solution are most valuable. Injections and irrigations of the bowels with other solutions are not of much avail in this acute stage, but are better adapted to the chronic stage. Hewes, however, claims that the injection of a pint of a 5 per cent. solution of silver nitrate retained for a half hour shortens and ameliorates the course of the disease. He has the bowel flushed with saline solution following each stool occurring after the injection with the silver solution. He repeats the injection of silver nitrate once after two days. Attention is called to the extraordinary strength of the silver solution.

For collapse in the acute stage stimulants such as camphor, alcohol, strychnin are to be used. Hypodermoclysis of normal salt solution is invaluable.

Treatment of the Chronic Stage.—Two main facts are to be borne in mind. First, the bacteria which are responsible for the disease are no longer present in numbers and do not play a rôle in the continuance of the symptoms. We have chiefly to deal with the secondary invaders, in the main streptococci. Second, this stage is truly a surgical condition, and to be treated as such. The bowel wall, especially at the flexures, is the site of numerous ulcers. Many of the latter are located in the rectum and sigmoid, within reach of the endoscopic instrument, through which they can be treated by direct topical applications of nitrate of silver (pure stick or in strong solution). Or we may try to reach these as well as those higher up by irrigations. It is customary to use silver nitrate in solution of 1-500 to 1-1,000, or even weaker strengths. Irrigations should be used with large quantities of fluid—at least one or two quarts—and the bowel should be subsequently flushed with salt solution to neutralize the excess of silver solution remaining in the gut. Other injections recommended are tannic acid, $\frac{1}{4}$ to $\frac{1}{2}$ per cent.; thymol, 1 to

500 to 1 to 1,000; methylene blue, 1 to 5,000; corrosive sublimate, 1 to 10,000; resorcin, 1 to 2 per cent.; creolin, 1 per cent. to 2 per cent.; lysol, 1 per cent.

When the disease persists through months and we are face to face with a state of affairs which threatens the life of the patient through inanition we are forced to consider more radical measures. Appendicectomy and irrigation of the colon and rectum from above have proven serviceable. Some cases are refractory even to this, and here an artificial anus should be made on the right side by bringing the ileum up to the abdominal wall. In this way we are able to give complete physiological rest to the colon and the rectum just as is done in malignant diseases of the lower bowel (with which, indeed, the condition has many features in common). After the ulcers have been healed and the patient has been restored to health a secondary operation may be performed to do away with the artificial anus and restore the normal state of affairs.

The use of drugs by the mouth has not been reported as satisfactory by most writers. Bismuth has been recommended with the idea of coating the ulcers, but it not only fails to do this but is open to the further objection that it frequently causes a false obstipation, and when the mass of accumulated bismuth has been removed from the rectum the diarrhea begins afresh. Intestinal antiseptics, such as benzonaphthol, salol, and the like, have been given, but without brilliant results. Equally futile are astringents, such as lead salts, tannin, and its derivatives.

DIET IN CHRONIC CASES.—Much greater freedom can, of course, be permitted than in the acute stage. Milk, eggs, cereals, meat in small quantities, and even puréed vegetables may be permitted. The diet must, of course, be individualized. In no case should food having large, coarse residues be allowed.

Infantile Diarrheas

Much of what has been said of the treatment of acute dysentery in the adult holds true in the treatment of ileocolitis of infants. Here again the important factors are the regulation of diet and the sweeping out of the intestinal contents by means of purgatives. As has already been remarked, milk is at once to be removed from the dietary at the first sign of intestinal derangement. Courageous starvation for twenty-four to forty-eight hours even is the wisest course. The child should, however, be given water freely during this time. After this, nourishment may be resumed in the form of whey, albumen water, lactose being freely added to these according to the suggestion of Kendall. Gradually there may be added thin gruels of barley, rice, arrowroot, starch, tapioca, or some of the proprietary carbohydrate and malted foods, meat juices, and broths. When milk is resumed it should be at first diluted much below the formula suited to a normal child of the same age.

Drugs.—With many calomel is the favorite drug, usually in doses of 1-10 grain every hour or two for ten or twelve doses, or gr. $\frac{1}{4}$ every hour for five or six doses. Others prefer an initial dose of castor oil (3i-5ss), according to age, followed later by repeated doses of gtts. x to xv (0.6 gm. to 1.0 gm.) every three or four hours, for its constipating effect. Bismuth subnitrate, bismuth subgallate, salol, are also used following the purgation, but in a large degree the objection urged against them under the head of adult dysentery holds true here. Bismuth, if needed at all, should be used only in the late stages. For the early and acute stage it is strongly condemned. Opium is frequently needed for the relief of pain. It may be administered by the mouth in the form of the deodorized tincture or of paregoric, or the tincture may be added to small starch water enemata, as already suggested for adults.

Daily colonic flushing with salt solution should be instituted from the beginning and maintained until the stools return to their normal character.

As most of these cases occur in the extreme heat of summer and in the crowded cities, it is all important to see that the little patient is removed when possible from the disadvantageous surroundings, and is kept in a cool and well-ventilated room. The garments should be thin and few. On the other hand, care must be taken to protect the prostrated child from sudden changes of temperature and from excessive loss of heat by radiation.

Frequent cool or tepid bathing or sponging is essential in febrile cases and grateful and stimulating in the nonfebrile cases.

The vomiting occurring early in the disease is best treated by gastric lavage. Repeated hypodermoclysis of normal salt solution serves to replace the excessive loss of water and to control the prostration.

[The general outline of treatment in children which I have employed for a great many years is as follows: I. When possible, rest in bed until all symptoms have disappeared. II. Food to be eaten warm; no milk, but Liebig's or Mellen's food, eggs, soups, beef tea, cocoa, or Racahout. III. The bowel should be kept empty of hard masses or collections of feces. Every case should receive a dose of castor oil as soon as the diagnosis is made, and this should be repeated whenever physical evidences, by palpation and percussion, show that masses exist in the colon. IV. After III has been carried out, and not before, opium in one form or another should be administered. V. Externally poultices are very grateful. VI. Enemata of cold water should be employed in the beginning. As the disease progresses rectal irrigations of warm water or oil are very grateful. Small quantities of warm water injected into the rectum after each stool give great relief, in addition to providing a more efficient emptying of the bowel. In this stage colonic irrigation is most valuable.—Editor.]

CHAPTER XIX

ANTHRAX

WILLIAM H. PARK

PROPHYLAXIS

Anthrax affects principally cattle, sheep, and horses, and from these is occasionally transmitted to man. The usual mode of infection in man is by contact with animals dead of anthrax, or by the handling of infected animal material such as wool, hides, etc. The disease is found all over the world. In Russia large numbers of horses are said to die annually from this disease, and the same is true of China. In Asia Minor the disease is prevalent among the Angora goats which supply much of the mohair of commerce. There is considerable anthrax among the countries along the Danube. It is also quite prevalent, though to a less degree, in England, Scandinavia, Spain, and Italy. From time to time the disease occurs in epidemic form.

Anthrax infection is caused by a large spore-bearing bacillus. The spores are resistant to heat and disinfectants. Animals can be infected by inoculation, by feeding, and even by inhalation of the spores.

In animal infections the bacilli may be given off in the urine, feces, or sputum. The fields and pastures frequented by the diseased animals thus become infected, and this infection is very difficult to destroy. Rational prophylaxis, therefore, involves the proper disposition of the bodies of animals dead of anthrax, the exclusion of animals from fields known to be infected, suitable disinfection of the stalls, and finally protective inoculation against the disease.

In man the disease is almost always traceable to contact with anthrax infection in an animal. Out of 604 cases collected by Morebach, 178 occurred in butchers, 31 in persons engaged in spinning horse hair, 31 in shepherds and cowherds, 24 in hostlers, 17 in farmers and owners of cattle, 4 in veterinarians, 3 in quack doctors, and 2 in meat inspectors. In addition to this, cases have frequently been reported in workers in tanneries and brush factories, in furriers, rag-pickers (wool sorters), etc. Laboratory workers have also been infected. The most frequent form of

anthrax infection in man is that of the skin, producing what is called "malignant pustule." A rarer form, first described in England, is called "wool-sorters' disease," and represents a pulmonary infection due to inhalation of anthrax spores detached from the infected wool. Occasionally the infection is primary in the intestine.

VACCINE AND SERUM TREATMENT

The development of vaccines for animals, although not applied practically in the immunization of man, is of interest.

In 1880 Toussaint reported that sheep could be immunized by injecting them with infected sheep blood heated to 55° C. for ten minutes. The heating, he believed, had destroyed all the anthrax bacilli. Pasteur, however, showed that this was not the case; the bacilli were not dead, but merely attenuated. In place of Toussaint's rather crude method of making such an attenuated vaccine, Pasteur devised the production of an attenuated culture by growing virulent anthrax cultures at high temperatures. In this way he was able to so reduce the virulence of the cultures that his Vaccine I was able to regularly kill white mice, but not always guinea-pigs. Vaccine II regularly killed guinea-pigs, but not always rabbits. In immunizing animals, forty-eight-hour broth cultures of these attenuated vaccines are employed. Cattle receive 0.25 c. c. of Vaccine I, subcutaneously, and after 12 days a similar quantity of Vaccine II. Sheep receive about half these doses. Rabbits, guinea-pigs, rats, and mice are extremely difficult to immunize. The immunity conferred on sheep and cattle by Pasteur's method of vaccination usually protects the animals against infection through the ordinary channels (stomach), as well as against injections of virulent cultures. The immunity lasts about one year.

It was found that the serum of animals artificially actively immunized against anthrax was able to confer a considerable degree of immunity on other animals. Selavo produced a serum of which 2 c. c. protected rabbits against an anthrax infection which killed control animals within 48 hours. Moreover, he was able to save animals in which the serum was injected as long as 12 hours after infection. The best results were obtained when the rabbits were injected intravenously with the serum, while the virus was given subcutaneously.

Immunization against anthrax can also be effected by means of the combined method, i. e., by injecting the animal simultaneously with specific antianthrax serum and anthrax culture. Ordinarily these injections are made on opposite sides of the body, the culture corresponding to Pasteur's Vaccine II. Cattle are injected with 5 c. c. serum and 0.5 c. c. of a suspension containing a loopful of culture in 50 c. c. sterile salt solu-

tion. In calves 0.3 to 0.5 c. c. of the culture suspension suffice. Horses require the same doses as cattle; sheep require 4 c. c. serum and 0.25 c. c. culture suspension. On the whole, the results of these combined immunizations have been very satisfactory.

In the production of the serum the best results have been obtained by immunizing sheep. So far as the technique of immunization is concerned, it does not differ from that employed in other cases of serum production. The animals are first made resistant against virulent anthrax, either by means of Pasteur's vaccines, or passively by the injection of specific antianthrax serum, or by the simultaneous injection of serum and culture. Once the animal is able to resist infection with a virulent culture, it is an easy matter to increase the degree of immunity by further injections. The immunization of horses and cattle can usually be pushed more energetically than that of sheep. The injections are ordinarily made at intervals of from 10 to 14 days, larger and larger doses being given. Subcutaneous injections have thus far given the best results. The animals are bled in from 2 to 3 weeks after the last injection.

The serum can successfully be used to protect sheep, cattle, and horses against infection, especially in those cases where it is desired to secure very prompt results. Ordinarily from 20 to 25 c. c. of the serum are injected subcutaneously. The serum appears to be useful, also, in the cure of infections in which septicemia has not been established. In this case from 25 to 150 c. c. of the serum are injected. Deutsch recommends from 20 to 30 c. c. injected daily until recovery ensues. In the treatment of anthrax infection in humans, Selavo recommends from 30 to 40 c. c. distributed in several parts of the body; if there is no improvement the following day the injections are to be repeated. In severe cases he recommends intravenous injections. Subcutaneous injections should be added. Thus far the only extensive employment of this serum in humans has been in Italy and in Argentina. The reports on the whole are favorable. In Italy, according to Selavo, the mortality has dropped from 24 per cent. to 6 per cent. In connection with statistics, however, it must be remembered that the prognosis in malignant pustule is not unfavorable, and most of the human anthrax infections have been of this kind.

The mode of action of antianthrax serum is not at all clear. Reasoning by exclusion, it has been held that its chief action is bactericidal. Yet, so far as can be discovered with our present methods, the bactericidal power of anthrax serum is not different from that of normal serum. It does not appear likely that the effect is due to opsonins, for, when animals are injected with anthrax bacilli plus normal serum, and with anthrax bacilli plus antianthrax serum, no difference in the degree of phagocytosis can be made out. In fact, Sobernheim occasionally found that phagocytosis was more marked with the normal serum. In highly im-

munized animals infected subcutaneously with large quantities of anthrax cultures, it is often possible to find living, virulent anthrax bacilli at the site of injection for days afterward. Moreover, cases have been observed in which the blood of immunized animals swarmed with anthrax bacilli a week or more after infection.

With the exception of the use of serum, the treatment of anthrax is wholly surgical. Caustic potash has been recommended as a caustic, the tissues about the pustule to be protected by adhesive plaster.

CHAPTER XX

HYDROPHOBIA

WILLIAM H. PARK

INDICATIONS FOR ANTIRABIC TREATMENT

While the indications for adopting antirabic treatment are in many instances clear, such is not invariably the case. As the matter is one of importance, we shall consider it somewhat in detail, taking up the different conditions as they present themselves to the practicing physician.

At the outset we wish to condemn the policy of some doctors who appear to feel that they are without responsibility in advising antirabic treatment unless they are furnished with a document vouching for the death from rabies of the animal inflicting the bite. In communities where this disease is fairly prevalent among animals the question should be: Can it probably be excluded in the biting animal? rather than, Can it be proven?

(1) When the animal is alive and apparently healthy, according to the diagnosis of a veterinarian, the indication is to keep it under observation for a period of one week and start the Pasteur treatment in the patient, only in case rabies develops in the animal during this time. The practice of killing an apparently normal dog in order to make a microscopic diagnosis of the brain, as such a dog is rarely diseased, and the microscopical diagnosis at such an early stage in the disease is somewhat uncertain, is not to be recommended. (2) If the animal shows symptoms of rabies, the treatment should be started in the patient at once. (3) If the animal has disappeared and cannot be found, one should attempt by every means to make a probable diagnosis. Thus, by ascertaining the appearance of the animal—whether sick or well, whether the bite was provoked or not, whether other animals or persons were bitten at or near the same time—information may be obtained, which, when considered in conjunction with the extent of the patient's wounds and the prevalence of rabies in the community, will enable the physician to form a fairly satisfactory opinion.

It is certain that in some of our large cities rabies is sufficiently com-

mon among dogs to warrant one's advising the Pasteur treatment for unprovoked bites of stray dogs.

So little is known of the symptoms of rabies by the general public that it is usually unsafe to be guided by the preformed opinion of the average layman, who usually believes that, unless a dog froths at the mouth or is unable to drink water, he cannot be mad.

We have known instances of intelligent persons being bitten by their own dogs, which were rabid at the time unknown to the owners, while the dogs were walking with them on the public streets. In one instance the bite resulted in the death of the patient from hydrophobia.

Remlinger states that in the public Pasteur Institutes of Europe probably one-half of the patients are treated unnecessarily, owing to the practice of giving the treatment to persons bitten by stray dogs in whom no diagnosis is possible. He nevertheless considers this practice advisable, in view of the fact that a few persons are thereby saved from death, though a number may be unnecessarily inconvenienced for a short time.

(4) When an animal has shown the clinical symptoms of rabies, but after death the microscopic examination of the brain fails to show the lesions of the disease, the case should be considered one of rabies, so far as the treatment of persons bitten by the animal is concerned. This, for the reason that the microscopical examination fails in about 3 per cent. to show the lesions in animals proven rabid by the inoculation test.

(5) When the animal has been killed and no examination made either before or after death, unless the history is against rabies, treatment is advisable in places where rabies is prevalent.

Before concluding the indications for treatment, it is well to call attention to the cases which are not actually bitten, but are merely exposed to the saliva of rabid animals. There can be no question that the free exposure to such infection, either with or without presence of excoriations of the skin, eczematous patches, hang nails, etc., may constitute an indication for treatment. We have knowledge of at least eight deaths from rabies which resulted from this mode of infection, and it is our custom to advise treatment where such exposure has been at all extensive. Animals in the first stage of rabies frequently show a marked tendency to lick their masters, and, when this disease is unsuspected in the animal, the excoriations thus licked are not cauterized, and frequently the saliva is not even thoroughly washed off. It would seem, also, that the licking might form a rather efficacious mode of inoculation from a mechanical standpoint.

PROPHYLAXIS

The prophylactic measures used against hydrophobia may be considered under the local treatment of the wound, and constitutional treatment.

LOCAL MEASURES

The most effective local measures are the production of free bleeding, wiping out or washing out of the wound with antiseptics or even with plain water, and the use of proper cauterization. Sucking out of the wound is recommended, but the mouth should be repeatedly rinsed on account of possible infection through abrasions about the mouth.

Some years ago an extensive experiment on the effects of cauterization in animals was performed at the laboratory of the N. Y. Health Department. The cauterization was done twenty-four hours after the infection of the animal by rabies virus. The agents used were the actual cautery, silver nitrate, and fuming nitric acid. In addition, two series of controls were used, one in which the wound was cleansed by simply scrubbing it out, and one in which nothing was done. The result of the experiment was as follows: Nitric acid saved 71 per cent. of the animals; the actual cautery, 54 per cent.; silver nitrate, 34 per cent.; the swabbing out had some effect, as shown by the fact that 15 per cent. of the animals in which this was done were saved.

Later another experiment was done in which the conditions simulated more nearly those found in actual clinical experience. Fuming nitric acid was used twenty-two hours after the wound was infected with virus. Forty per cent. of the animals were saved by the cauterization.

It has been our custom, therefore, to use nitric acid in practically all cases where a cautery was used at all. The wounds are opened up, scabs being removed, and the acid applied either with a capillary pipette or with a swab of cotton on glass or wooden holder. In the case of children with extensive wounds upon the head chloroform anesthesia is generally used by us. In other cases, where necessary, cocain or, better still, alypin, may be used either by injection into the tissues or applied directly to the wound. It is advisable not to apply nitric acid directly to the periosteum, but to use carbolic acid in this situation. Contrary to the general opinion, it is our experience that wounds treated with nitric acid heal well, with comparatively little scarring. When applied to wounds on the lower extremities in elderly persons and those with poor circulation, an ulcer may result. As this is the least dangerous place from the standpoint of infection, it is usually advisable to use one of the less severe caustics in these cases. We generally use the above method of cauterization even up to the end of forty-eight hours after the bite, when there has been no previous treatment of the wound, or when this has been carelessly performed. The local treatment is most important in the case of bites upon the head and exposed parts of the body. It is simply in the nature of an adjunct and should not supplant antirabic vaccination, although when promptly and properly performed it is probably sufficient to prevent infection in some cases where the wounds are very slight.

CONSTITUTIONAL MEASURES

The constitutional treatment of a person suffering from the bite of a rabid animal, but who has developed no symptoms, consists chiefly in

the Pasteur antirabic vaccination, or some modification of it. While the mode of action of this vaccination is not altogether understood, it is believed that it is quite similar to that of the bacterial vaccines.

The injections of the modified virus produce antibodies in the serum of the patient which inhibit the growth of the virus from the wound, along the nerve tracts, thereby producing an active immunity. The serum of an animal which has received an extensive series of such injections contains "antirabic" properties which are easily demonstrable in the test tube.

In Pasteur's earliest attempts at immunization he used the cords of rabid dogs as they were brought to his laboratory from the street. The virus in this form he called "street" or clinical rabic virus. He found, however, that equal weights of such brains emulsified in equal amounts of salt solution contained an unequal number of organisms, or at least reproduced the disease, when inoculated into the brains of laboratory animals, with varying periods of inoculation. In order to develop a definite system of vaccination which would be applicable at all times, it was necessary to obtain a virus which was stable or fixed in strength, so that a given amount of it (roughly a given number of organisms) could be obtained at any time. This result he attained by passing the virus from a dog's brain (street virus) through a series of rabbits, reinoculating each rabbit in the brain with an emulsion made from the brain of a rabbit previously inoculated. With each passage he found that the virulence of the brain emulsion was increasing, as shown by the shorter incubation of the disease in each succeeding rabbit, until finally, after about 50 passages, the incubation had fallen from 2-3 weeks to 6 days. Below this point it did not fall in spite of numerous subsequent passages. In other words, the virus had reached its greatest possible strength for this method of inoculation, and was called by Pasteur "fixed virus." Having then obtained a virus of definite strength, the next step, which was much simpler, was to devise a method of attenuation so that it could be safely administered to a human being.

The spinal cord rather than the brain was used, it being more easily manipulated. Drying was the method of attenuation, and it was found that, when the cord of a rabbit which had died of fixed virus infection was dried over caustic potash in the dark, at a temperature of 70° F., for a week, the virus had been completely killed. Dried for a shorter time down to one day, the cord was active to produce the disease when inoculated, subdurally, with successively shorter incubations, until a cord dried only one day produced rabies with the same incubation as the fresh virus, i. e., six days. The original scheme of the Pasteur method was to begin the treatment with an injection of six cubic centimeters of an emulsion made by grinding up a measured amount of a cord dried fourteen and a like amount of one dried thirteen days in physiological salt

solution. The next day a similar dose from an emulsion of cords dried twelve and eleven days was used. The third day cords of ten and nine days' drying, and the fourth day those of eight and seven days' drying, were used.

The remainder of the scheme was as follows:

Day of treatment	Age of cord	Amount of emulsion injected
5th	dried 6 days	2 c. c.
6th	" 5 "	"
7th	" 4 "	"
8th	" 3 "	"
9th	" 5 "	"
10th	" 4 "	"

This routine is repeated until the patient has been treated for fifteen, eighteen, or twenty-one days, according to the severity of the disease.

By the repeated passage of the rabic organism through a long series of rabbits, it has not only become heightened in its virulence for subdural inoculation, but at the same time it has been changed and rendered less virulent for subcutaneous inoculation, so that it is probable that a considerable quantity of the perfectly fresh virus could be inoculated subcutaneously in man without producing the disease.

Since the time of Pasteur many modifications have been made in the treatment, the therapeutic principle remaining the same in all. Some recommend the use of killed virus only throughout the course of treatment, while others use only the fresh, undried virus. Various agents of attenuation are used, and, even where the Pasteur drying method is employed, some laboratories start the treatment with an emulsion of a cord dried only three days, and later use that of a cord dried one day. As it is not clear to us that proof has thus far been produced to show that the above-mentioned modifications are advantageous, the original Pasteur method has been adopted with a few minor modifications.

The routine of the preparation of the virus at the New York Health Department is as follows: From two to four rabbits are inoculated subdurally each day with a few drops of an emulsion made from the medulla of a rabbit which has just died of fixed virus infection. In six days these rabbits show the first signs of rabies, and, when fully paralyzed two days later, they are asphyxiated by illuminating gas. After death the animals are washed and immersed in a 1-20 carbolic solution. After this they are carefully skinned by cutting the hide around the hind quarters and drawing it over the head. The tissues along the course of the spinal column are then flamed with a bunsen burner, and, after cutting through the soft parts, the two ends of the spinal column are severed with bone

forceps. The cord is then pushed out of its canal with a cotton-wrapped probe—the whole operation requiring only a few minutes. A small portion of the cord is planted in broth for possible contamination, and the remainder is suspended in a jar containing caustic potash, and placed in the drying room.

The emulsions are made by grinding measured quantities of the dried cords with the proper amounts of physiological salt solution.

Throughout the process the greatest care is taken to avoid bacterial contamination. The duration of the treatment is from sixteen to twenty-six days. The inoculations of the patient are made subcutaneously, preferably in the abdominal region. Patients bitten on the head are treated morning and evening for the first two days. The scheme of injections followed is that of the original advocated by Pasteur, with a few minor modifications.

Antirabic serum—that is, the serum of a highly immunized animal, such as the sheep or horse—has not been found to be of use in the preventive treatment when used by itself. For the past few years, however, it has been employed at the Pasteur Institute in Paris in the following manner: An emulsion of fresh fixed virus is killed by mixing it with a strong antirabic serum. The mixture is then centrifuged and washed free of the serum. This serum-killed virus is used during the first four days of treatment, the rest of emulsions being of the usual dried virus. By the use of this modification it is claimed that immunity is more rapidly produced.

Local and Constitutional Effects of the Inoculation.—The local effects of the treatment consist of erythema, itching, and burning about the site of puncture, following the inoculations of the middle third of the course of treatment. Usually these symptoms disappear of themselves, but should they persist, as may happen when the abdominal wall contains much fat, the application of cold for a short time, or of a wet dressing, such as acetate of aluminium, will be sufficient. Abscess formation practically never occurs. Frequently no constitutional symptoms occur during the entire course of treatment. On the other hand, it is not uncommon for patients to complain of slight lassitude and somnolence. Some patients lose weight and become slightly anemic; others gain in weight. The anemia and loss of appetite may be partly due to the mental worry which some patients acquire while undergoing treatment for the bite of a rabid dog. There appears to be nothing in the material injected which affects the heart, blood, or kidneys.

It should be the aim of the physician to keep the patient in as good general health as possible while undergoing the immunization. Insomnia, which is occasionally noted, is to be treated by the use of such drugs as trional; loss of appetite by tonics. Tea, coffee, and alcohol should be used sparingly. The patient should have ample exercise, but overfatigue

and exposure to cold and wet are to be avoided. Where necessary, the mental condition of the patient should receive attention, as he is sometimes inclined to be highly nervous or depressed and melancholic. In delicate, nervous children the injections may produce a certain degree of shock, and this, added to the shock from the attack of the dog, may require careful handling on the part of the doctor and parents.

A case in point is that of a delicate three-year-old girl of inherited neurotic temperament, who was attacked by a large dog, rolled in the street, and bitten by it in seven places. Through bad management at home the child's mind was kept continually upon her unpleasant experience. The daily trip to the laboratory for the painful injection added to the patient's distress, so that a troublesome insomnia developed, resulting in a condition of nerve exhaustion lasting several months. Naturally the injections should be made as easily and as quickly as possible, and tact should be exercised by parents and doctor, so that the children may go through with their unpleasant experience in as good condition as possible. Under such circumstances children stand the treatment surprisingly well.

Complications.—As occasionally happens in the use of therapeutic sera, or even of drugs, so, following the Pasteur vaccine, one encounters at times an idiosyncrasy on the part of certain patients, which results in a greater or less degree of toxemia. That this is due to an idiosyncrasy is shown by the fact that usually but one out a large number injected with the same lot of vaccine develops symptoms. Predisposing factors in addition are supposed to be exposure to cold and wet and nephritis and alcoholism. In our experience only adults have been affected. Our records show nineteen cases in 4,400 patients treated, or one in 230.

As this condition proves fatal in but extremely rare instances, the pathology is not well understood. The poison affects the nervous system, and has been termed, according to its severity, neuritis, myelitis, and acute ascending paralysis. The period at which the symptoms are most apt to develop is from the beginning of the last week of treatment to the end of the second week following.

In the great majority of these cases, according to our experience, the symptoms are mild, being limited to paresthesia of the limbs or neuralgic pains, the latter usually limited to the spine and sciatic nerves. These symptoms may last from ten days to several weeks, and in the latter case may be accompanied by loss of weight and muscular weakness. More rarely there may be actual paralysis of one or more limbs, usually in the form of paraplegia; and, when involving the lower extremities, the bladder and rectum are frequently involved. More rarely still, the paralysis takes the form of the ascending type, and, while even these cases are apt to recover, they are occasionally fatal. It has been estimated that one out of six thousand cases receiving the Pasteur treatment dies from this

complication. This estimate we believe to be too high. There is no treatment for this condition other than rest and attention to the elimination from bowels and kidneys.

The injections may be suspended or not, according to the case. It has been stated that their continuance does not affect the duration of the symptoms. Whereas this very rare complication of the Pasteur treatment should not influence us against advising the vaccine in those who evidently need it to protect them from rabies, it should be considered in those cases in which the apparent risk of infection from rabies is negligible. In other words, the treatment should not be recklessly advocated for psychological effect upon the patient.

Treatment Sent by Mail.—For some time past the New York Health Department has sent out the Pasteur antirabic virus to physicians, to be given by them to the patients at their homes. The virus is sent each day by special delivery mail to those places which can be reached within 24 hours. A somewhat longer and stronger course is sent than would be given were the patient treated at the laboratory, in order to make up for the slight loss in strength of the virus. One-quarter of one per cent. of carbolic acid is added to the emulsions of the first four days, and 20 per cent. of glycerin to those of the subsequent days of treatment.

Recently a number of manufacturing firms have added the Pasteur antirabic virus to their list of other vaccines, and are sending out the emulsions in syringes ready for use.

Provided physicians attend carefully to the few details of the administration of the virus, the results seem to be good. Many persons are able to take this treatment in this manner, who would be unable to spare the time and money necessary for a sojourn of three weeks in a distant city.

While it may be somewhat more satisfactory in a few cases to have the patients come to the laboratory for treatment, it must be said that, in the great bulk of the cases, this method of administration is distinctly advantageous to the patient.

Results of Treatment.—The Pasteur treatment requires four to five weeks for the full development of immunity, of which time about three weeks are required for giving the injections. In a person who is taking the treatment there is a contest of speed between the passage of the virus from the wound to the brain, by way of the nerves, and the development of immunity by the absorption of the vaccine through the circulatory system. The Pasteur Institute of Paris estimates, as failure of the treatment to immunize, only those cases which die of rabies after the expiration of a two-week interval following the period of injections, this being the full time required for the action of the vaccinal injections. Those cases which die within this time, whether due to delay in starting treatment, susceptibility of the patient, or intensity of infecting virus, are

not included in their mortality statistics. In patients bitten upon the head the incubation is apt to be short, and in such cases the percentage of patients which die during the period of treatment is, therefore, larger.

Some idea of the mortality from rabies in patients who have taken the Pasteur treatment may be obtained from the following table, based upon a record of 2,405 cases bitten by animals known to be rabid. These patients were treated with virus from the N. Y. Health Department laboratory from May 10, 1906, to September 19, 1911:

Location of bite	Total mortality	Mortality after the expiration of the period of observation
Head, 261 cases.....	4%	.3%
Other parts of the body, 2,144 cases..	3%	.2%

In other words, if a person escapes infection up to the end of the two-week interval following a full course of treatment, the chances of rabies developing later are reduced to two or three in a thousand.

It is estimated that 15 per cent. of persons bitten develop hydrophobia, if their wounds are not treated and they do not receive the Pasteur treatment. The reduction in mortality brought about by treatment was in our cases from 15 per cent. to 3.1 per cent. Even better results would have been obtained if all those who died had come promptly for treatment.

TREATMENT OF THE DEVELOPED DISEASE

As rabies in the human subject is practically always fatal, very little can be said upon the treatment of the disease after it has developed. One or two cases of recovery have been reported by reliable authorities, and several recoveries of animals from rabic infection have been recorded, so that every reasonable effort should be made in the patient's behalf. The surroundings of the patient should be such as to tax his supersensitive nerves as little as possible. He should be upon a narrow bed, so placed as to be accessible from both sides, so that he can be easily controlled should he become violent. It is well, in the case of strong persons, to have some form of restraining apparatus easily accessible in case of need. The patients do not all become violent, but those that do become so are apt to be extremely hard to control.

Although liquids cannot be swallowed, semisolid food, such as ice cream, can be taken fairly well, and may afford temporary relief from thirst. Some effect may be produced by enemata of large doses of chloral and the bromids. Morphin is usually given hypodermically, but is ineffectual in therapeutic doses. If the paroxysms are severe, as they may

be shortly before death, the only effectual means of controlling them is by the use of chloroform given intermittently, as in eclampsia. With regard to the use of curative drugs, it may be mentioned that Friedburger and Sachs report saving two dogs with a combination of atoxyl and thioglycocholic acid. The use of arsenophenylglycochol is also recommended.

It is important for those who nurse a case of hydrophobia to guard against becoming infected themselves. Although the saliva of the human case is not as infectious as that of the dog, nevertheless, some risk is incurred, should it penetrate the epithelium.

It is wise, therefore, for the attendants to wear gloves and to attend to the prompt cauterization of wounds that have come into contact with the patient's saliva.

I am indebted to Dr. D. W. Poor, who has charge of the Pasteur Department in the Research Laboratory, for assistance in preparing this article.

CHAPTER XXI

TETANUS

WILLIAM H. PARK

The treatment of tetanus has two distinct purposes: first, the neutralization of the tetanus toxins in so far as that is possible, and, second, the allaying of the symptoms and the keeping alive of the patient.

THE USE OF ANTITOXIN

The neutralization of the poison which is free in the blood, lymph, and tissue fluids can undoubtedly be accomplished by an intravenous injection of tetanus antitoxin. That which is already thoroughly united to the tissues of the nerves, spinal cord, and brain is probably beyond the influence of the antitoxin. There is, however, apparently an interval of time in which the toxin is in contact with the cells' surface, or is free in the cells' fluids, before true union takes place. According to experiments by Kraus, part of this toxin will pass out of the cells if they are surrounded by an antitoxic fluid, just as salts pass through a membrane into salt-free fluids. It is important to clearly understand that in case of tetanus the toxins elaborated in the infected wound have passed into the lymph vessels, and the greater part poured into the general blood supply, and from there passed out to the tissue fluids, and there, coming in contact with the nerve endings and the cells of the nervous and muscular system, have been taken up by them. The symptoms are the proof that serious poisoning has already taken place, and that more is impending, for symptoms do not arise until some hours after the contact of the cells with the toxins.

While the nerve tract leading from the wound is somewhat more involved than the rest of the nervous system, still there can be no question that the great mass of the toxin passes into the blood from the lymph, and so gains access to all divisions of the nervous system.

The neutralization of the poison which has not already come in con-

tact with the tissue cells is certainly accomplished when tetanus antitoxin diffuses through the capillary walls to the tissue fluids. As already mentioned, it is probable that some of the toxin which has entered the cells or the nerve endings may also be neutralized and prevented from poisoning. This takes place more rapidly when the fluid outside is strongly antitoxic. The longer the toxin remains in the cells the greater will be the proportion which has combined with the cell protoplasm and is beyond any possible neutralization by antitoxin.

The above facts make it imperative that at the earliest possible moment we give a sufficient dose of antitoxin by some method which will make it possible to quickly reach the tissues.

Method of Injecting Antitoxin.—From the fact that tetanus toxin passes up the nerve trunk, or its lymph vessels, which supplies the tissues involved, it was urged that antitoxin be injected directly into the nerve trunk. The direct injection of the nerve trunk can do no harm, and probably does block a certain amount of toxin ascending, which would not be reached as quickly in any other way. The fact remains that the major part of the toxin enters the blood, and is thus conveyed to all parts of the body.

Since the tissues of the spinal cord and brain are chiefly affected, it has been suggested that the antitoxin be injected into the spinal canal or the cord or into the ventricles. It is possible that intraspinal injections affect certain portions of the central nervous system more quickly than those given by any other method. Subarachnoid injections do not, however, come into contact with more than the surface of the cord, while the deeper portions are equally affected by the toxin. The effect on the deeper portions is probably the same as any other form of injection. That is, the antitoxin must first be accumulated in the blood before passing out to the tissue fluids bathing the cells.

The intracerebral injections act in the same manner, and on account of their danger and shock should not be attempted.

The question of giving antitoxin subcutaneously, intramuscularly, or intravenously is to be decided by the rapidity of absorption.

An intravenous injection, throwing the antitoxin directly into the blood current, causes an immediate neutralization of all toxin present, and, within a few hours, of all toxin in the lymph and cellular fluids. A subcutaneous injection is not wholly absorbed for three days. The water holding the antitoxin in solution is quickly absorbed, but the antitoxin is held back. At the end of six hours only about 10 per cent., 24 hours 35 per cent., 48 hours 65 per cent., and at 72 and 96 hours 100 per cent.

The following table of the results in two goats receiving 10,000 units brings this point out clearly:

Hours after injection	Goat 1, subcutaneous Units of antitoxin in	Goat 2, intravenous one c. c. of blood
3	1	85
6	2	75
12	5	70
24	9	60
48	17	35
72	25	25
7 days	8	10

The slowness of absorption of that injected subcutaneously is very evident. The blood current, in fact, never reaches in antitoxin strength to within 50 per cent. of what it does after an intravenous injection of the same size. Injected into the muscle, the antitoxin is absorbed about three times as rapidly as when given subcutaneously, so that the major part is absorbed within twenty-four hours. The effectiveness of this method also falls far short of the intravenous way. It is also difficult to be certain that the antitoxin is actually injected into the muscle substance, and that it is retained there until absorption.

Single or Multiple Injections.—The usual method of giving antitoxin is to give an injection every six to twelve hours during the first day and every twelve hours after that time until the symptoms improve. It is difficult to find any reason for the frequent dosage.

As one looks at the table above, the conviction becomes strong that after the first twelve hours all the toxin in the body not firmly united to the cell substance has been neutralized and that all we have to do further is to keep the blood antitoxic so that any toxin still in the infected area will surely be neutralized. It would seem that one large intravenous dose of antitoxin given at the very first possible moment to be followed at intervals of 48 hours by moderate sized subcutaneous injections until the symptoms abated would be all the antitoxin required. The important thing is to give sufficient antitoxin at the first possible moment.

Danger in Delay.—Every minute that passes without giving antitoxin after the first symptoms appear makes its effectiveness less. If for any reason one cannot at once give it intravenously, it should be given subcutaneously. If only a small amount is at hand, give it immediately, and later give the remainder.

There is practically no danger in giving it intravenously if ordinary surgical cleanliness is used and the serum is warmed to about blood heat.

Dose.—The dose should be in proportion to the size of the individual. It is far better to give too much than too little. The severity of the case influences rather the prognosis than the dosage.

For an adult of average size an injection of at least 15,000 units should be given. If the expense is not too great and it is available, 25,000 units would be better. As the refined tetanus serum usually contains

about 500 units per c. c., the amount of fluid will be about 30 to 50 c. c. For a child of less than fifty pounds one-half this amount will suffice; for an infant one-quarter. This large amount of antitoxin is not given because there is a large amount of toxin in the body, but because, as only a small percentage of the antitoxin passes out of the blood to the cellular fluids, it is necessary to have great antitoxic strength so as to quickly get the antitoxin in appreciable amount to the cells. The tissue fluids only contain about 3 per cent. of the antitoxic content of the blood.

If the full amount is not available, give at once whatever quantity is at hand. The first thousand units given intravenously undoubtedly does the largest amount of good. It is probably wise to give additional doses every 48 hours of 5,000 units in an adult and one-half that amount in a child until the symptoms abate. This keeps up the antitoxic strength of the blood. I am not sure that these later injections are necessary, but they can do no harm.

I have treated twelve cases in this manner and the results have convinced me that many cases of tetanus are seen early enough to receive great benefit from antitoxin. I am certain its prompt use will save many lives which would otherwise be lost. It is unfortunately true that it will fail to have marked effect in some of the most acute cases.

Treatment of the Infected Area.—This should be treated by the ordinary surgical methods, so as to remove any collection of pus and any necrotic tissue. Amputation of infected limbs should not be done unless required for other reasons than tetanus. In many animal experiments Field, in the Research Laboratory, showed that the shock of amputation did more harm than the toxins, if sufficient antitoxin had been given.

Prevention.—A subcutaneous injection of 1,500 units in an adult and of 1,000 in a child will prevent the development of tetanus in the great majority of infected wounds. A second injection ten days later will absolutely insure protection. The second dose of antitoxin is necessary in cases of serious injury, because it is eliminated slowly and little remains after ten days. These immunizing injections should be given after blank cartridge wounds, ragged wounds where dirt has been carried in, and crushes. In regions where tetanus is prevalent this is very essential. The antitoxin can be given at any time during the first few days, if it is not available at once. The wound should be treated surgically so as to remove, as far as possible, all dirt.

The injections of carbolic acid have not, in animal experiments, shown any power to neutralize the tetanus toxin. Tetanus develops as rapidly and as fatally as in controls.

DRUG TREATMENT¹

Anodynes and spinal sedatives are usually employed, and with an advantageous result in mild cases. They have no power to cure, but

¹ I wish to thank Dr. Bartholow for his assistance in preparing this section.

there is no doubt that they relieve pain and diminish spasm, and so conserve the strength and possibly prevent suffocation. To produce these effects in mild cases, or any effects at all in the acute and severe cases, large or very large doses are necessary; and it may well be that some of the remedies in these amounts are not devoid of danger.

Bromid of potassium, the safest and one of the most effective, may be given in much larger quantity than writers usually advise; indeed, an abundant experience shows that the human body will tolerate two drachms at a dose without harm. In tetanus it is desirable that such doses be administered by the stomach or nasal tube, or by the rectum, and be frequently repeated. The effect is enhanced by adding chloral, of which 15 grains (1.0 gm.), 30 grains (2.0 gm.), and even 60 grains (4.0 gm.) may be given every six to twelve hours; its dangers perhaps being exaggerated. Yet, undoubtedly, it is a judicious caution to watch its effects, and to govern the dosage by the effect produced.

The spasms are also powerfully influenced by the preparations of Calabar bean, notably the fluid extract and the sulphate of eserine. Both must be pushed, eserine being given subcutaneously in doses of $1/6$ grain (0.01 gm.) every three hours until its physiological effect is shown in fibrillary twitching of the muscles and diarrhea. This drug may properly be mentioned here, not that it is, as a remedy, any great favorite at the present day. Other remedies, little used now, but esteemed by the older physicians, are conium, gelsemium, nicotine, aconitine, and amyl nitrite. The last is most useful, but all require practice and a special knowledge to be employed with success.

If the current opinion be true, chloroform is a remedy of peculiar excellence. It is given in large doses at a single time, 40 grains (2.6 gm.) in olive oil by the rectum, and 120 grains (8.0 gm.) in twenty-four hours (4). Unfortunately its action is obscure, and Begbie reports a case in which it may have had some influence in causing death (2).

Some cases are greatly benefited by chloroform inhalations during severe spasms, and may even absolutely require it. No remedy for tetanus, however, has been more indiscriminately used. On this point the differences between doctors are profound; but there is a growing conviction that the prolonged administration of chloroform is harmful.

Similarly morphine and atropine are valued highly; but these are not cures, and are both used and abused. They have special uses—to relax the muscles and produce sleep; and atropine has a particular merit—that of drying the mucus in the mouth and throat. Morphine, when used, should be combined with atropine, but atropine may very well be used alone. Few remedies are more easy to interpret; the signs of toxic action in atropine are particularly legible. Large doses of both drugs should be given, and Leyden rightly advises .02 gram of morphine ($1/3$ grain). During the 24 hours 0.1-0.15 gm. can be given. Atropine should be in-

jected into the rigid muscles, the maximum dose being $1/25$ grain (0.0025 gm.).

Of late years two forms of "symptomatic" treatment have been before the progressive physician: (1) with phenol. (2) magnesium sulphate.

Bacelli's method is the subcutaneous injection of large doses of phenol. The results claimed are most striking (1). He uses a 2-3 per cent. solution in water, and begins by administering 0.3 to 0.5 gram of carbolic acid daily, divided in several injections. He then increases the quantity to $1\frac{1}{2}$ grams daily. Maragliano recommends a 5 per cent. solution in oil. Bacelli claims that it lessens the nerve excitability of the spinal cord, lowers the temperature, and has antitoxic properties. The method has been approved by many, while others have had little success with it. In animal experiments it appears to have little or no effect—certainly much less than antitoxin. The statistics given show a remarkably low mortality—of less than 10 per cent. These figures are undoubtedly too good.

In my own experience the results have not been striking and I am sure that if given it should be in addition to, and not in the place of, antitoxin. The urine must be carefully watched.

2. Magnesium sulphate is administered in two ways: subcutaneously and into the spinal canal. It is not easy to discriminate between what is more and what is less beneficial in them. The subcutaneous method is doubtless the safest and easiest; it has also proved useful (10). A slight overdose has caused dangerous and profound collapse, as in Miller's case (6). Deaths are reported by Page, Phillips, Debré, and Tanton, and, though cures occur, a close examination of many shows that antitoxin, bromids, chloral, and atropin were also used. The chief danger is from respiratory failure—a danger only avoided by very careful dosing. Meltzer's original dose was 1 c. c. of a 25 per cent. sterile solution to every 25 pounds of body weight. This dose by some is slightly reduced.

The technique of the injection may be thus described: A lumbar puncture is made between the third and fourth vertebræ. The patient should be placed on his left side with the head slightly raised, to prevent the solution from flowing into the medulla and paralyzing the respiratory center, an accident, nevertheless, which has more than once taken place. Chloroform may be required, but should be avoided where that is possible. If the puncture is successful, a small amount of the spinal fluid is allowed to flow through the needle, and it is then affixed to the syringe containing the solution of magnesium sulphate. The method, which should be practiced by the expert alone, is dubious to a degree. For, as Taylor writes: "The treatment is symptomatic, can only be partial, and is not free from danger" (9).

In this enumeration of remedies the properties of pilocarpin should be mentioned, as indicated by clinical observers and the researches of Madsen and Salomonsen. It merits a trial, as also do the organic preparations of arsenic.

Inhalations of oxygen are advised by Osterwald for the spasms (7).

GENERAL MEASURES

Feeding.—All food given by the mouth should be in fluid form, so as to be easily swallowed, and this should in severe cases be kept as small in amount as possible, as there is danger of foreign body pneumonia and of exciting convulsions. Rectal feeding should be used to supplement mouth feeding. The tendency to spasm of the sphincter aids the retaining of the injection. As much as two or three pints may be retained daily. Leyden suggests as a combination 500 c. c. milk, 50 grams nutrose, and one teaspoonful salt. To this brandy and tincture of opium can be added.

Feeding through a soft rubber catheter passed to the stomach by the nostrils is often necessary. Sometimes, owing to spasm, the tube will not pass. Chloroform inhalations will then be necessary. Sometimes it is easier to pass a small stomach tube by the mouth. Subcutaneous injections have at times been resorted to. Olive oil and 10 per cent. solution of grape sugar have been employed, also normal horse serum. As much as 500 to 1,000 c. c. can be given. Before passing a nasal tube for feeding or giving an injection in the bowels, or doing anything which might cause a convulsion, it is well to give a dose of morphin, so as to lessen the irritability.

Nursing.—Every noise possible should be eliminated, and the room should be somewhat darkened.

A water-bed will make the patient more comfortable, and prevent to some degree the starting of spasms.

Results of Treatment.—The most acute cases have a very high mortality. The longer the incubation and the slower the onset the better the results. If every case were given an intravenous injection of antitoxin at the time of diagnosis, and treated well in other respects, probably 50 per cent. would recover.

PREVENTIVE TREATMENT IN DETAIL

This consists in the use of antitoxin and the treatment of the wound. The instructions printed for hospital internes by Berghausen are so good that I repeat them:

“1. All perforating, penetrating, or lacerating wounds contaminated directly by soil or manure, especially those contracted in the streets or about stables.

"2. All blank cartridge and giant-cracker perforating and lacerating wounds.

INSTRUCTIONS

"1. In all cases above mentioned remove the clothing and foreign material about the wound.

"2. Cleanse the surrounding parts with green soap, alcohol, ether, and sterile water.

"3. Remove with sterile forceps any foreign material lying superficially in the wound.

"4. Cleanse the wound with 5 per cent. phenol (carbolic acid), 0.5 per cent. hydrochloric acid solution.

"5. Enlarge the opening by free incision if necessary, to thoroughly cleanse the wound, or for the removal of foreign substance.

"6. Use a general anesthetic whenever indicated.

"7. Pack the wound lightly with gauze soaked in the phenol-hydrochloric acid solution, and dress. Change the dressings daily.

"8. Immediately after dressing the wound on the first day give 1,500 units of antitetanic serum subcutaneously.

"9. A careful record must be kept of each case when the patient is discharged."

In case of doubt or on the appearance of symptoms resembling tetanus an injection of 20,000 units of antitoxin should be made at once. When the diagnosis is certain it may be too late. If it is tetanus the symptoms will become manifest in spite of the antitoxin, but will probably not develop to an alarming extent.

THE TREATMENT OF ACTUAL CASES

This disease is so rare that few physicians see more than one or two cases. The following reports, giving treatment of various kinds and results, are given, because in this way a clearer idea can be obtained than from the general consideration already given.

Two Moderately Severe Cases of Slow Development Treated with Antitoxin and Sedatives, One Case Having Two Relapses

Case 1.—Boy, aged 10; admitted with history of injury twelve days previously. On ninth day rigidity of muscles of lower jaw developed with slight convulsive seizures.

On the twelfth day, when admitted, was subject to repeated convulsions lasting sometimes a few seconds and sometimes ten minutes. During the next five days there were each day 8 to 15 severe convulsions. The first relaxation of the jaws took place on the sixth day of treat-

ment. On twelfth day patient ceased to have convulsions and recovery was uninterrupted.

Treatment.—On each of the first five days two doses of 3,000 units of antitoxin were given subcutaneously; on the next two 3,000, and on each of the next five 1,500, a total of 55,000 units in all. Pint enemas of normal salt solution were given daily at first, and patient was fed through a tube.

Chloral and sodium bromid, each ten grains, and morphin, $\frac{1}{8}$ -grain doses hypodermically, were given as required. On admission the wound was carefully treated.

Comments.—The first dose of antitoxin should have been at least 10,000 units, and should have been given intravenously. Single daily doses of three thousands units of antitoxin would have kept up the antitoxin content of the blood sufficiently. The immediate large intravenous dose is the most important point to be insisted on.

Case 2.—A moderate attack with two severe relapses. This case, reported by Fink (3), is similar to one treated by me six years ago. The patient, 20 years old, was admitted ten days after infection of a sore with cow manure. His temperature and pulse were normal, but the spasms severe. When the spasms were very severe injections of morphia were given, and occasionally inhalations of chloroform. Chloral, 20 gr., and sodium bromid, 30 gr., in mixture, was given every three hours. Antitoxic serum was given twice daily in doses of 10 c. c. After four days the spasms became less, and ceased after another four days. Four months later he had a second attack, and after two months a third attack.

In this case there was probably some remaining spores which developed after the antitoxin administered and that elaborated in the person had been eliminated. In the case that came under my observation I gave an injection of 1,000 units every two weeks for three months after the third relapse.

Two Cases of Tetanus Treated by Subdural Injections of Magnesium Sulphate (8)—Cases 3 and 4

Case 3.—On September 28, 1911, Ronald R., aged 9 years, complained of feeling ill, and did not go to school. The following morning the patient had a violent tetanic seizure, and was ordered to the hospital. He was admitted at 1 p. m., the temperature then being 99.4 and the pulse 112.

The boy had been in the habit of running about barefoot, and there were several small cuts and abrasions on both feet. The cuts were carefully cleaned, and then swabbed with tincture of iodine, and a gauze dressing applied.

As soon as the wound had been dressed the boy was put to bed, and 1,500 units of antitetanic serum given subcutaneously. At 3 p. m. the

patient had a tetanic seizure which lasted two or three minutes; risus sardonicus was well marked, and from this time on there was great difficulty in opening the mouth.

Similar attacks occurred at 4 P. M. and at 5.15 P. M., and a second dose of 1,500 units of serum was then given. The temperature had risen to 100.2°. The attacks now recurred with increasing frequency, until they were almost continuous.

At 2.30 A. M. a third dose of 1,500 units of serum was injected, and under chloroform anesthesia the spinal canal was punctured between the third and fourth lumbar vertebræ and 2.5 c. c. of cerebrospinal fluid was withdrawn, and there was slowly injected in its place a like amount of sterile 25 per cent. solution of magnesium sulphate.

After the injection of the magnesium sulphate the patient slept quietly for an hour, and then quite suddenly the breathing became embarrassed, and the temperature fell to 97°. As the breathing became steadily worse, a small hypodermic of strychnin was given, and repeated in half an hour's time. The boy's condition distinctly improved, and he took liquid nourishment well.

At 10 A. M. on September 30 the temperature rose rapidly to 104.6; cold sponging was resorted to, and the temperature fell to 100°. The boy slept all the afternoon, and seemed on the high road to recovery, until the early hours of October 1, when the temperature again rose to 104°. Cold sponging now had no effect on the temperature, and the breathing again became very embarrassed. Strychnin was administered and oxygen given, but the boy's condition gradually became worse, and he died at 10.40 A. M., the temperature immediately before death being 107°.

From the moment the magnesium sulphate was injected to the time of the boy's death no trace of tetanic spasm occurred.

The dose recommended is 1 c. c. of a 25 per cent. solution for every 25 pounds body weight, but from the effect of the drug in this case I am inclined to think this dosage too large. A large dose of antitoxin might have been of use in this case.

Case 4.—On November 9, 1911, Vera H., aged 8 years, while running about barefoot, cut her foot on a stone. The wound was treated at home until November 22, when the child, who appeared to be out of sorts, was brought to the hospital.

On admission temperature and pulse were normal. The foot was soaked for twenty minutes in 1 to 4,000 solution of mercury perchlorid, and then dressed with a boric acid fomentation.

The patient was put to bed and slept well all night, but at 7 A. M. on November 23 she had slight muscular twitchings and complained of pain in the back and of difficulty in opening the mouth; 1,500 units of antitetanic serum were given subcutaneously, and the wound on the foot

swabbed with tincture of iodine. Five grains of potassium bromide were given every three hours.

The muscular twitchings continued at intervals all day, and the temperature rose steadily, until at 5 p. m. it had reached 104°. Under chloroform anesthesia 1,500 units of antitetanic serum were injected into the subdural space, an equal quantity of cerebrospinal fluid having previously been withdrawn.

The tetanic symptoms persisting, a hypodermic injection of 1/16 grain of morphine was given. As the bladder was distended, the catheter was passed, 20 oz. of urine being withdrawn. The patient passed a restless night, and the following morning (6.30 a. m.), under chloroform anesthesia, 1 c. c. of a 25 per cent. sterile solution of magnesium sulphate was injected into the subdural space.

This procedure was followed by a distinct improvement, and the muscular spasms ceased until noon, when they recurred with increased violence and frequency. A second hypodermic injection of morphine was given with great benefit, the child becoming quieter, getting a fair amount of sleep, and taking nourishment well.

At 10 p. m. the convulsions returned, the attacks coming on about every hour till 4 a. m., when they ceased, and the child slept till 7 a. m. Severe attacks of tonic and clonic convulsions then came on, recurring every few minutes throughout the day. More morphine was given, but had no effect.

At 4 p. m. a frightful attack of convulsions took place, the body being violently jerked about the bed, and death ensued ten minutes later.

The patient suffered from retention of urine the whole time she was in the hospital, and the catheter was passed as required. During the forty-eight hours preceding death the temperature was high, and cold sponging was resorted to frequently, and seemed to have a very soothing effect. Immediately before death the temperature rose to 108.2°.

In this case Smithson thought the amount of magnesium sulphate was too small, but feared at the time to give more. The amount of antitoxin as in the first case was too small and should have been given intravenously.

Two Cases in Which the Treatment Given was Antitoxin and Chloretone

Case 5 (5).—Acute tetanus; recovery. Male; white; aged 10. Incubation, ten days; duration, sixteen days; splinter in foot.

On August 5 the patient ran a splinter into his foot; the wound was dressed and apparently healed in two or three days. Patient was first seen by me on August 17, at which time there was difficulty in opening and closing the jaws. Two days previously he had noticed some slight stiffness and pain on opening the mouth. He was immediately admitted

to the hospital at 2.50 p. m. as a tetanus patient. The temperature on admission registered 102.5°. Though apparently healed and hard to find, the place of injury was opened and a piece of tissue removed and wound thoroughly cauterized. A splinter was found imbedded in the tissue over half an inch in length. Under ether anesthesia 3,000 units of antitoxin were given intraneurally into the sciatic nerve of the leg below the groin, and 3,000 more intravenously by the median basilic vein of the arm. The symptoms continued to increase steadily with rigidity, convulsions, arching of back, and rising daily average temperature, and disassociation of the normal pulse and respiratory rhythm up to the tenth day of the disease. The condition of the patient at this time was decidedly serious. On the eleventh day (day beginning at 3 p. m.) the temperature had risen to 104.5° F., pulse 156, respiration 38, and remained with small change at this point until 4 a. m., when a marked change occurred for the better, the temperature falling 4.5° to 100° F., pulse 116, and respiration 24 per minute, the first material fall of temperature, pulse, and respiration since the third day of the attack. The improvement in the general condition continued until, on the sixteenth day, the temperature touched normal, pulse 96, respiration 18. Decreasing stiffness and irritability continued for some days later. The last convulsion was recorded on the twelfth day. From the splinter were recovered classical tetanus bacilli, which caused tetanus in guinea-pigs. From the time of the ether anesthesia until the eleventh day, as occasion required, chloretone was given in solution by rectal enema in 30-grain doses. Complete relaxation followed each dose, lasting from eight to sixteen hours, during which time the patient slept quietly. Antitoxin was given daily subcutaneously in doses of 3,000 units. Liberal nourishment was supplied by nutrient enemata and stomach tube feeding. Saline solutions with frequent laxatives were used to promote elimination by the skin and kidneys.

The marked change in the temperature chart between the tenth and eleventh day, almost in the nature of a crisis, should be noted.

Case 6.—Acute tetanus, traumatic. Male; colored; Barbadian; aged 34; machinist's helper; incubation, ten days; duration, eight days, nineteen hours; fatal.

On August 9, at about 9.30 p. m., the patient's foot was crushed by an engine. On admission half an hour later foot was amputated at tarsometatarsal joint. Sloughing of the flaps occurred five days later. August 20, ten days from injury, noticed some stiffness in opening and closing of the jaws. Under ether anesthesia 3,000 units of antitoxin were given intraneurally into the sciatic nerve of leg, and 6,000 units intravenously in the basilic vein of arm. From this time daily 3,000 units of antitoxin were given subcutaneously, and, as symptoms required, chloretone in 60-grain doses by rectal enema. As in the previous case,

relaxation followed promptly, continuing from eight to sixteen hours and even longer, the patient resting and sleeping quietly. Laxatives, salines, and nourishment as in Case 1. No amelioration occurred in the regular progress of the disease. The temperature, pulse, and respiration continued more erratic, until on the eighth day at 4 p. m. it stood at 104.5° F., pulse 140, respiration 40. Death took place the next day.

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CHAPTER XXII

GLANDERS

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Glanders occurs in almost all parts of the world, and is found especially in horses, donkeys, and mules.

Glanders is occasionally communicated to man by contact with infected animals, usually by inoculation on abraded surfaces of the skin. A number of investigators have shown that infection through the intact skin is most unlikely. Viborg (cited by Wladimroff) showed that the same was true for mucous membranes, for he was able to place virulent glanders virus on the nasal mucous membrane of horses without infecting them. Infection occurred only when the virus was vigorously rubbed in. The relatively frequent occurrence of primary nasal glanders in horses is not surprising, when one considers the extreme liability of these parts to minute abrasions from the horse's food. The use of common drinking troughs or of common buckets is also believed to be an important factor in the spread of the disease in horses.

From what has already been said concerning the pathology of glanders infection, it is obvious that the pus from the ulcers and the secretion from the infected mucous membranes constitute the greatest source of the spread of the disease. Moreover, glanders bacilli may be present in the feces of infected animals, even though there are no intestinal lesions. This is comparable to the presence of tubercle bacilli in the feces of animals infected with pulmonary tuberculosis, and is due to the swallowing of the bacilli with coughed-up sputum or with infected nasal secretion.

So far as our present knowledge goes, a moderate immunity against glanders follows an attack of the disease.

Attempts have been made to produce artificial immunity against glanders in animals, and these are of interest, as the knowledge obtained can be applied to the treatment of subacute cases in man. Immunization has been attempted with an endotoxin prepared from glanders bacilli, and, while a certain degree of tolerance for this endotoxin could be produced, only a slight immunity against glanders infection was manifest.

Since the introduction of mallein as a diagnostic agent we have learned that chronic glanders in horses does not infrequently end in spontaneous recovery. Working with cultures attenuated with glycerin and also with dead cultures, Levy (3) appears recently to have successfully immunized animals against virulent infection, and Dedjulin (2) reports very favorable results in a small number of horses. Silkman, in New York City, has treated many horses with three immunizing injections of 2½ c. c. of a killed broth culture of the glanders bacilli, with apparently favorable results.

So far as specific treatment of glanders infection is concerned, a number of different procedures have been tried. Thus the serum of horses ill with glanders has been injected into animals suffering from glanders, and favorable results are said to have been obtained. The number of cases thus treated, however, is too small to permit definite conclusions, and confirmatory observations are lacking. In view of the fact that cattle are relatively immune to glanders infection, Nicolle (4) has experimented with defibrinated ox blood as an immunizing agent, and believes his results warrant further trial of the method. In the hands of other investigators the results have been unsatisfactory.

Wright, Bristow, and White, and recently Cramp (1) and Zieler (5), report recovery from glanders in man following the administration of bacterial vaccines. We know of two subacute cases which recovered under this treatment. In view of the very grave prognosis in these infections when treated by the ordinary methods, treatment with bacterial vaccines should be tried in all except possibly the very acute cases. The doses employed have varied somewhat, and will depend on the degree of reaction produced. It is well to begin with injections of twenty millions, increasing gradually up to two hundred millions, or to a point where a definite reaction is produced. The injections are usually given every four or five days, but may in smaller doses be given every two days.

There is no non-specific treatment for glanders which differs from that suitable for any other acute infectious disease. The discharges from the nose and mouth and from any lacerated surfaces should be carefully looked after and disinfected.

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CHAPTER XXIII

ACTINOMYCOSIS

WILLIAM H. PARK

Actinomycosis is a chronic disease occurring chiefly in cattle, but also in man, and caused by infection with a fungus, *actinomyces bovis*, commonly called the ray fungus.

Although the organism has not yet been positively detected outside of the body, there is considerable reason to believe that infection ordinarily occurs with the food. Johne, for example, noted that the tonsils of hogs often contained barley grains, whose surface or terminal hairs were covered with this fungus. Similar observations were made by Bostrom, who examined the jaws of 32 cases of bovine actinomycosis. He found the grains of various kinds of cereal deeply imbedded between the teeth and gums, as well as in the actinomycotic lesions of the tongue. The grains were studded with actinomyces. There is no evidence of direct infection of man with the flesh or milk of diseased animals; in fact, no case is known where a direct history of human contagion has been obtained. When systematic examinations are made of the pus, etc., of all patients treated, actinomycosis is found to be not uncommon. When this is not done a considerable number of the cases are diagnosed as tuberculosis or syphilis. The disease is more common in farmers, millers, and others who are brought in contact with grain, than it is in others.

The experimental production of actinomycosis in animals with material directly from cases, or with cultures, has been followed by negative or very unsatisfactory results. The organisms introduced are either absorbed or encapsulated. It seems probable that in order to produce typical infection some additional irritant is required.

According to most observers, the tendency to suppuration is much more marked in man than in cattle, where the process, too, is more localized. In man, in addition to the localization in the jaws, infection of the lung, intestinal tract, and skin is not uncommon. The course of the disease is very chronic, and may or may not be marked with fever of an irregular type. The diagnosis can only be positively established by finding the actinomyces in the lesions or in the pus.

In man spontaneous recovery from the generalized disease is rare, death resulting usually in from six to twelve months. Actinomycosis of the skin, jaw, and lymph nodes is amenable to surgical treatment, and this includes extirpation, incision, cauterization, etc. For those forms in which surgical treatment is out of the question, preparations of iodine, both internally and as external application, have been used with considerable success in cattle. In man, too, favorable results have been observed from the administration of potassium iodide, though mostly in cases involving only the head and neck. In the pulmonary and intestinal forms the results have not been favorable. The doses employed in man have been from one to two grams daily, gradually increased up to four and five grams. If accessible, the affected parts should also be treated with local applications of iodine or with compresses saturated with a ten per cent. solution of potassium iodide.

So far as I know, no successful results have been obtained from the use of vaccine or serum. I believe treatment by vaccine should be tried in resistant cases.

CHAPTER XXIV

THE GENERAL AND SPECIAL TREATMENT OF SYPHILIS

WILLIAM S. GOTTHEIL

INTRODUCTION

Of all the more serious infections syphilis has for many years been regarded as perhaps the most regular and orderly in the sequence of its phenomena; and the simplest and most responsive in its treatment. The orderly succession of the primary, secondary, and tertiary symptoms and the efficacy of the usual mercury-iodin treatment were assumed; and any deviation from the usual in these respects was regarded as sufficient to cast doubt upon the diagnosis. So far had this gone that it might almost be said that any case which did not present the expected and orderly sequence of symptoms was very likely to be unrecognized or misconstrued by the practitioner; and the useful though much abused "touchstone of treatment" was regarded as a decisive test, no matter how imperfectly applied. The treatment of lues became a matter of routine to an extent that militated greatly against its efficiency.

I would not be understood, however, as protesting against the attempt to marshal the phenomena of the disease in sequence and to standardize the remedial measures to be employed. It can be done successfully in this disease to a greater extent, probably, than in any other infection; and it is a practical necessity. The affection lasts for so long a time that it is the exception for one and the same observer to see both its earlier and later phenomena in one patient. And its ultimate results and sequelæ are so varied that not even the specialist can know them all. The general practitioner needs broad therapeutic lines for guidance.

Until a few years ago syphilology was apparently at a standstill. The main facts of its history were well established, and its therapeutics was supposedly settled. There were many dark points, of course. Its etiology was entirely unknown, though it had long been evident to many teachers, myself included, that a living organism alone could explain its phenomena. In recent times, however, the indefatigable efforts of a multitude of workers have begun to bear fruit; and syphilology has apparently entered upon a new phase of its history that is full of hope for the future. In 1903

it was for the first time demonstrated by Metchnikoff and Roux that certain anthropoid apes were susceptible to syphilis; and thus the disease was admitted into the field of experimental medicine. It was true that, in the course of centuries, there had been occasional instances in which experimental inoculation had been done; but these were either isolated instances of self-sacrifice on the part of physicians or experiments like those of the Anonym of the Palatinate, in which the secrecy entailed by illegal acts robbed the experiments of most of their value. Once any animal, no matter how rare or expensive, was proven to be susceptible to inoculation with the disease, syphilis was thrown open to medical experimentation, and might be expected to show the same advances that other similar maladies have.

These advances were not long in coming. In 1905 Schaudinn and Hoffmann discovered the spirochete; and the rapid confirmation of their findings in all quarters of the world soon settled the etiology of the disease. The long-sought-for agent that occasioned the malady was found at last. True, it had long been known that some factor of the kind was necessarily present, as no other agent would explain the phenomena of the disease. True also it was that the last quarter of a century preceding had been filled with alleged discoveries of the causative agent; about one a year was the average. But their finders were, in almost all instances, the sole believers in their etiological importance, and not one of these discoveries was confirmed. The spirochete, however, has remained, and is firmly established in the six years that have elapsed since the epoch-making discovery. It has been found in every possible phase of the disease; it has been successfully inoculated in monkeys; it has even lately been cultivated; and it is now a well-established and universally recognized criterion of the existence of the malady.

Following this came the discovery of the specific serum reaction by Wassermann. This was a diagnostic means that enables us to recognize the disease in the absence of ordinary symptoms. Its status, however, is not as yet fixed; it is still not entirely beyond the experimental stage. The marvels of syphilitic animal inoculation and of the spirochete seemed to have prepared the medical mind to receive with comparatively little questioning any advance in our knowledge of the malady that has been mysterious so long. As its usefulness is chiefly in diagnosis, its detailed consideration is not in place here except in so far as it may be an aid in treatment. From this point of view it will receive some consideration further on in these pages. It will not be out of place, however, to sound a note of warning as regards the serum reaction. For there is a marked and lamentable tendency to overestimate its meaning and importance. It is merely a symptom of syphilis, and is of value, like other symptoms, when present; its absence does not necessarily mean absence of the disease; and, as a matter of fact, we already know of the existence of factors that may

interfere with its positive development when syphilis is indubitably present. It may even be called a secondary or subsidiary symptom; for the best authorities on the reaction will admit that, where a positive sign of the disease of the ordinary kind is present, as, for instance, a mucous patch, the serum reaction is of little importance. Moreover, the test consists of a complicated and delicate series of chemical reactions; so that its value depends largely upon the skill of its maker. Finally, and above all, admitting that the complement fixation test has been properly and skillfully made, and that the possibility of disturbing factors, such as anti-syphilitic treatment, and the presence of the few other affections that seem to give the same reaction have been eliminated, the patient may have an indubitably positive Wassermann reaction, and his symptoms may still be due to an entirely different cause; a syphilitic is not immune from other infections, accidents, or tissue changes. The very evident present tendency to overestimate the importance of the serum test, to regard it as absolutely decisive, and to rely upon it to the virtual exclusion of other symptoms is decidedly wrong. It is merely an additional symptom of the luetic infection which may be elicited when others are absent, and possessing an especial value in doubtful cases.

Last in the series of syphilis discoveries has come the new arsenic therapeutics, or rather the old arsenic therapeutics in its new and improved form. The discussion of arsenobenzol, or "Salvarsan," will necessarily occupy a large space in a monograph written at this time and devoted to the treatment of the luetic disease. A new therapeutic development of necessity followed the etiological and diagnostic discoveries of the last eight years. In how far the new treatment has been successful, to what degree it has fulfilled the expectations of its promulgators, will be seen in the following pages.

A systematic consideration of the treatment of syphilis will include all the problems of prophylaxis, of hygiene, of the specific medication, both local and general, in all its details, as well as the approved methods of handling its various complications, and the special manifestations of syphilis in pregnancy and in the inherited disease. The subject is a large one, and it cannot well be laid out on any logical plan based either on symptoms or on therapeutics. The main desideratum in a system such as this is to present the material in a readily accessible and usable form. The practitioner seeking information on a certain point should be able to find it without trouble. It will therefore be best considered under the following heads:

The Hygiene of the Syphilitic.—This includes all the personal and general physical measures to be employed, the special hygiene of nervous system, sexual organs, mouth, etc., the consideration of the influence of various other maladies and intoxications.

The Prophylaxis of Syphilis.—Here will be considered briefly the

various factors that predispose to contagion, the contagiousness of the various lesions, and the manner in which the virus may be transmitted, the points of personal and social prophylaxis, the prevention of syphilis in the married state, and, finally, the important prophylactic measure of chancre excision.

The Indications for Treatment.—Under this heading, in addition to the generally accepted points, will be included a consideration of the serum tests as a guide and indicator in the management of the disease.

The Specific Medication, Mercury, Iodin, and Arsenic.—Here will be considered the modes of absorption and elimination of the drugs, their various methods of administration, the contraindications to and accidents from their use, and the general scheme of the specific medication.

The local specific medication, including the treatment of the various luetic accidents and complications.

Finally, the *treatment of the syphilitic sequelæ, the treatment in the pregnant and married states, the treatment of infantile and hereditary syphilis, and the auxiliary medication* will be detailed.

To a large extent the therapeutic measures advocated in the following pages embody the results of nearly thirty years' experience with the disease in all its various phases. The opportunities for observation, investigation, and experiment in various public and private institutions, and more especially in the City Hospital of New York, with which I have been connected for many years, and whose syphilis wards contain an amount and variety of material unequalled on this continent, have led me to conclusions which may not yet be universally received, but which have stood the test of time, and are being more and more generally accepted. The methods advocated are those which experience has taught me to be the best. More especially in regard to the newer propositions in syphilotherapy each succeeding week brings new evidence of the correctness of the position that I assumed in my earlier writings on these subjects. At all events, I can say that not the textbooks of authorities and not the writings of eminent foreigners, but personal observation and clinical study are the basis of the recommendations contained in the following pages:

THE HYGIENE OF THE SYPHILITIC

This is a factor in syphilotherapy to which little attention is generally given, and yet it is one whose importance can hardly be overestimated. Of the three factors that determine the severity of any infection, the virulence of the invading organism, the strength of the resisting tissues, and the amount of aid that treatment can bring, only the two latter are in any way under our control. I am firmly convinced that the first factor is a variable one, and that future investigation will demonstrate the differ-

ing virulence of different strains of the spirochete. For, while the average infection runs a regular and comparatively mild course, the disease phenomena following one another in orderly succession, and rational treatment controlling the manifestations without difficulty, we occasionally meet cases which are violent to explosiveness, in which the very earliest lesions are extensively destructive, in which tertiary symptoms appear while the chancre is still present, and in which the whole course of the malady is that of a profound and even fatal infection. In some of these cases it is true that there is evidence of the influence of the factors of soil resistance and treatment. The malignant course of the malady may be ascribed to debility from alcoholism or debauchery, or to the influence of tuberculous, malarial, or other infections. In others, again, inefficient or improper treatment, or an entire absence of treatment may be blamed for the malignancy of the disease. But there remain some cases, luckily few in number, in which none of these factors can be blamed. The patients are in robust health and lived under comparatively favorable hygienic and social conditions, and treatment has been carried out *secundem artem*. The only possible explanation of these cases is inoculation with a specially virulent microbic strain.

It is my belief that such exist in certain localities, more especially in China and the East, and in the West Indies. At all events we have learned in the City Hospital to expect an especially severe syphilis in natives of these regions, or in persons who have acquired their syphilis there.

The second factor in determining the severity of a syphilitic infection, as well as the third one, is, to a large extent, under our control. I have long taught that, in the ordinary run of cases, the difference between a mild and manageable syphilis and one with obstinate, distressing, and even dangerous phenomena depends more on the patient's condition than on any one other factor. Hence the supreme importance of so regulating the patient's life that the powers of resistance of his tissues will be raised to the highest possible point. And this task includes the institution, not only of the measures of general hygiene, but also the hygiene of the special organs, and the regulation of the use of intoxicants, tobacco, etc.

Physical Hygiene.—All measures calculated to raise the patient's general physical tone are useful, more especially regularity and quietude of life, abundance of sleep and rest, plenty of fresh air, nutritious and readily digestible food, moderate exercise and recreation, etc. Violent or exhausting labor should be avoided if possible; and exercise should be varied and moderate. Cold spongings daily will do much to keep the skin in good condition and improve its powers of resistance. The occasional use of the Turkish bath, or ordinary warm baths twice a week, is advisable; as is rational hydrotherapy. Where outdoor exercise, walking, horseback riding, golf, or tennis is not available, regulated gymnasium exercise can be substituted; but all of these should be indulged in well within the limits of fatigue or they may do more harm than good. City people especially

suffer very frequently from a sedentary life and want of exercise, combined with excessive or overrich eating; and for them a very exact regimen and exercise should be prescribed. The patient must never be allowed to forget that, no matter how well he may apparently be, he is passing through a serious infection which may be doing damage of which he is entirely unaware. Hence, even mild excess of any kind, either of work or of play, is to be avoided; and dissipation, that under ordinary circumstances would be quite harmless, must be cut off. Late hours, suppers, heavy dinners, long sojourns in smoke-laden atmospheres, etc., are all bad. The patient's attention should be entirely directed to leading a regular, moderate, and tonic life. Mental quietude and the avoidance of worry and care are important factors, though but too frequently they are not within our own or the patient's control.

Nervous Hygiene.—Under this heading there is much to be said of prime importance. The nerve structures themselves are very susceptible to the action of the infection in all the stages, even the very earliest, of the disease. The persistent headache that is almost an invariable symptom of the first stage is sometimes merely a part of the general systematic disturbance occasioned by the spirochete invasion; other signs of which are the fever, anorexia, constipation, pains in the limbs, and general malaise. But not infrequently the headache is entirely too severe and persistent to be attributed entirely to this cause, and is evidently due to a distinct meningeal hyperemia. In the worst cases, especially such as are without any or efficient treatment, the meningeal symptoms may be severe and obstinate enough to show the presence of a definite, low-grade meningitis, the clinical symptoms of which are recognizable, and which eventuates in a general meningeal thickening, as has been abundantly proven at the autopsy table. Sciatica, neuritis, and other not uncommon involvements of the peripheral nerves, both in early and in late syphilis, are abundant evidences of the extent to which the nervous system is attacked by the disease. I need do no more than refer in passing to the syphilitic paralyses and to the spinal and cerebral syphilis ending in tabes and general paralysis.

These things are a part of the recognized symptomatology of the infection; but there is another set of psychic phenomena to which much less attention is paid, and which are of especial importance at the beginning of the disease when a general plan of treatment is to be inaugurated. Syphilitics may be divided broadly into two classes: On the one hand are the patients who believe that they have suffered an absolutely irreparable misfortune, that their lives have been wrecked, and that a loathsome and shameful disease, which they have acquired through their own fault, deprives them of all prospects of future health and comfort. Thoughts of suicide are likely to occur; and not a few of the unexplained or supposedly accidental deaths occurring in young people are to be

attributed to their execution. On the other hand there are the patients of the type of those who regard a gonorrhea of as little moment as a coryza, who have had or whose friends have had "chancres" often before, who refuse to believe in the serious nature of their trouble, and who demand only to be relieved of their immediate difficulties. They are luckily the smaller class of the two; for they are dangerous patients, both to themselves and to others, and are difficult to handle.

Obviously, these two classes of patients must be managed differently. We know the truth about the disease; we are aware of its immediate dangers as well as of its far-reaching deleterious effects. We know also that many cases recover entirely, sometimes even with inefficient treatment, or with none at all. But we cannot predict, in any one case, what the outcome, treated or untreated, will be. We know only that in the vast majority of cases we can control the symptoms and keep the infection within its regular and moderate bounds.

We cannot, with any of the means thus far at our disposal, eradicate the infection; but we can promise, and I do promise, an ultimate cure, barring certain unavoidable accidents.

In all cases the information as to the nature of the disease from which the patient is suffering should be given gently and with circumspection. It is occasionally a question whether it is proper to withhold it, as when a husband who has infected his wife desires concealment. I have always absolutely refused to be a party to any such procedure; not only from the necessity of the patient's knowing the gravity of the condition and the need of careful and prolonged treatment, but also because of the impossibility of taking the necessary precautions for the safety of others when the patient is not aware of the danger herself.

The majority of patients, as I have said, need reassurance and encouragement; and no detail of the nervous hygiene is of greater importance. They should be told that syphilis is a curable, though a serious, disease; that multitudes of those who have contracted it regain their normal health, lead useful and happy lives, reach old age, and have flourishing families. A prudent reticence as to unfortunate accidents occurring in the course of the disease is advisable and safe; for, after all, it is only a very small minority of all those who have contracted the infection who have malignant cases, or subsequently develop paresis or tabes. For those of the careless class it may be advisable to dilate upon the dangers, both to the patient and others, involved in the disease; but my experience is that such efforts are useless with this kind of patient; he knows more about it than the doctor, and he will do what he likes anyway. In no case, however, would I adopt the plan that I am informed was pursued by a late syphilographer, who, when he diagnosed the presence of a luetic infection, would with tears in his voice and if possible in his eyes commiserate the patient on the dreadful misfortune which had overtaken him.

The nervous hygiene of the syphilitic also includes the careful avoidance of all depressing influences, worry, care, overwork, etc. I fully realize the difficulties that may be in the way of enforcing mental equanimity in certain cases; but we must do our best, if necessary enlisting the aid of friends and relatives.

Sexual Hygiene.—This difficult problem must necessarily be considered in every case. Theoretically, of course, a patient affected with syphilis should avoid all sexual congress during the entire active stage of his disease; and I recommend this, inasmuch as I am not a believer in most of the supposed ill effects of prolonged continence. Practically, however, there are other factors that demand attention. As the individuals affected are, in most cases, males in the prime of life, we cannot rely on or enforce sexual abstinence for years at a time, more especially during the periods when, as the result of a properly conducted treatment, the patient is apparently well for months at a time. Under these circumstances the dangers of the situation must be thoroughly explained, especially as regards the mouth. For a patient with genital lesions is not apt to have intercourse, while he may regard his even more dangerous buccal or throat lesions as innocuous. The patient must be instructed to look upon even the slightest physical lesion as dangerous to others; kissing should be avoided entirely; and the use of a condom certainly diminishes the danger of spreading the infection.

With married people the problem is somewhat different. If the other partner is already infected no further damage can be done, and no rules other than the ordinary ones as to moderation, etc., need be laid down. If one partner is still uncontaminated, then total abstinence during the entire infective period is to be advised. I have grave doubts as to the completeness with which this is carried out, for there are social and other considerations that inevitably lead to its modification.

In a general way, then, the matter stands as follows: Sexual intercourse must be restricted as far as possible, and is to be permitted only under circumstances which render it perfectly safe to both parties concerned.

Hygiene of the Mouth.—Since the early infective and dangerous lesions are more prone to appear in the buccal cavity than anywhere else in the body, that region should receive especial attention. The patient must be minutely informed of the danger to himself and others; and, if he lives with others, separate eating, drinking, and toilet utensils must be employed during the entire first year of the disease and as long thereafter as infective or suspicious mouth lesions are present. The responsible head of the family, at least, must be informed of the condition so that the necessary precautions may be taken. It goes without saying that the patient should sleep alone, and, if possible, in a separate bedroom.

As regards the patient himself, a dentist should be consulted at once and the mouth put in the best possible condition. It is often a matter of some difficulty to get this done: because I insist on the dentist being informed of the patient's infection in every case, for the protection of himself and others. This makes the patient's regular or family dentist often unavailable and he must go to a stranger. The mouth should be regularly and carefully inspected at least once every two

weeks during the first year of the disease; for the lesions are often insignificant at first, cause very little pain or discomfort, and are liable to be regarded as an ordinary pharyngitis or other trivial complaint. Careful instructions should be given for the avoidance, as far as possible, of acid, peppery, or other irritant food; for the regular and careful use of the tooth brush and a proper mouth cleanser. I have no special criticism to make of the various washes and simpastes that are used; but I am certainly of the opinion that no one of them is better than many of them not so good as, an ordinary bland soap. Any one of them whose taste is not repugnant to the patient will do perfectly well.

Finally, the cleaner the mouth is kept and the more perfect the condition of the teeth, the less likely are buccal lesions to appear, and the quicker will they be cured if they do come. It is well to recommend the regular use of a mild antiseptic mouth wash of thymol, carbolic acid, etc. Two excellent ones for general use are the following:

℞ Thymol, gr. v (gm. 0.30). ℞ Tinct. iodin, dram i (4.0 gm.).
 Mentholi, gr. x (gm. 0.6). Aq. dest., ounces vii (210.0 gm.).
 Tinct. eucalypti, dram i (gm. 4.0). M. S.—Gargle.
 Alcoh. absol., ounce i (30.0 gm.).
 M. S.—4-5 drops to a glass of water.

(**Alcohol and Tobacco.**—All the chronic intoxications necessarily have an unfavorable effect on the infected patient; and the above two are so common that special attention must be paid to them. The deleterious action of alcohol is both local and general. Its irritant effect on the mouth favors the development of buccal lesions and renders them worse and more obstinate when they are present. Chronic alcoholic intoxication, on the other hand, is a well-recognized factor in determining the gravity of any infection, and especially that of syphilis. The alcoholic is a bad syphilis patient, prone to have serious cerebral, spinal, and special sense-organ involvements, and often responding imperfectly to treatment. It is well, therefore, where it is possible, to forbid alcohol entirely; and where that cannot be done to limit its use as far as possible.

The dangers of tobacco are on the one hand more evident, and on the other more deep seated and subtle. Smoking and chewing irritate the mouth and throat, predispose the patient to have mucous patches and gummatous lesions, and keep them up indefinitely when present, in spite of the most vigorous treatment. The more serious affections of the mouth of late syphilis are often due to the combined effect of tobacco and the virus; and the mucous patches, the glossitis, or the gummatous infiltration are often quite incurable as long as smoking is kept up. The French authorities even speak of a *glossitis syphilonicotique*; and the origin of that most obstinate and distressing post-syphilitic affection, leucoplakia buccalis, with its not infrequent termination in cancer of the mouth, is probably to be found in the combined effects of the two noxæ. Besides

this, tobacco has a well-recognized deleterious effect on the gastrointestinal tract, the nerves, and the entire system. It is well, therefore, for the patient to give up the use of tobacco entirely if he can; and, where that is impossible, it should be restricted as much as possible, and an attempt be made to minimize its local ill effects by a careful cleansing of the mouth after it has been indulged in.

Influence of Other Local and General Maladies.—When general infections of any kind are present in a person acquiring the syphilitic one, the prognosis is, of course, rendered more serious. Patients with tuberculosis or paludism are bad syphilitic subjects, as are those suffering from anemia from any cause, or those debilitated from affections of any kind, or by old age. It is true that there is a prevalent idea that the contrary is the case; that tuberculous patients or very old people have a mild syphilis if they acquire it. I believe this to be an error; some of the most malignant cases which I have ever seen have occurred in just such patients. The treatment of these antecedent or concomitant conditions may be considered to form part of the hygiene of the syphilitic; but their consideration here is naturally out of the question. They must be treated *secundem artem* so that their presence interferes as little as possible with the measures required for the syphilitic infection itself.

THE PROPHYLAXIS OF SYPHILIS

Much that has been said under the heading of personal hygiene applies to the prophylaxis of the disease; but a number of important points remain for our consideration.

Factors Predisposing to Infection.—Uncleanliness is a self-evident factor in the infection; the virus takes an appreciable time to effect an entrance into the tissues, it is on the surface at first, and can undoubtedly be removed by the vigorous use of soap, water, or the various antiseptics. When we remember the Magdeburg experiments, which showed, by the serum test, that practically every prostitute who had been two years on the town was syphilitic; and also the many chances of transmission of the virus afforded by a single female with infective lesions, it is evident that multitudes of men are frequently exposed; and yet only a small proportion contract the disease. I have no doubt at all that this comparative immunity is to be ascribed more to the free use of soap and water than to any one other factor; and this is further proven by the fact that fewer cases of syphilis are contracted from prostitutes, who are cleanly as a matter of business, and with whom intercourse is usually had under conditions that make cleanliness possible and favor it, than from the so-called clandestine prostitution or intercourse under conditions where cleanliness cannot be so easily observed.

Intemperance favors infection, not of itself, but because it tends to induce prolonged, excessive, or violent intercourse, and to cause neglect of the sanitary precautions; the majority of infections, in my experience, have been acquired while under the influence of liquor. Bad hygienic conditions or depressed vitality from any cause are possible predisposing factors. Undoubted ones are certain occupations, which I need merely mention. Physicians, nurses, midwives, and workmen in various trades where tools are used in common are more exposed than others, and often contract the disease extragenitally.

Contagiousness of the Lesions and of the Normal Secretions.—Since the spirochete lives only in a fluid medium, dying very soon when desiccated, it is the moist lesions of all kinds that are dangerous. Lesions covered with normal epidermis are not contagious provided that epidermis is not ruptured. Mucosal lesions, being covered only with a thin and readily removable layer of cells, are dangerous even when not eroded. All lesions of the so-called primary and secondary stage are contagious when they are moist or readily vulnerable. And since, in the earlier and more dangerous stages of the disease, the blood contains the virus, even lesions of nonsyphilitic nature may be infective at that time. The only safe rule is to regard every lesion as contagious during that period. Tertiary lesions, long supposed to be noncontagious, have been proved, by animal experimentation, to be so, at least occasionally, by Neisser, Finger, Landsteiner, and others. The virus is attenuated, however, and is probably not a frequent source of infection. Heredosyphilitic lesions are contagious in the same way and to the same degree as those of the acquired disease.

As regards the normal body fluids, any of them may become contagious by contamination with secretion from an active lesion; so that contagion occasionally occurs through the milk, the saliva, the nasal and bronchial mucus, etc. They do not normally contain the virus. But the blood does, at all events in the early stages of the infection; and so does the semen, as is shown by the occurrence of paternal heredosyphilis, and as has been proven experimentally.

Modes of Contagion.—Contagion, of course, may be immediate; that is to say, the virus may be directly transferred by contact of an infected with an uninfected person; or it may be mediate, some inanimate object or a third person being the carrier of the virus. Surgical and dental instruments, toilet and table articles, pipes, penholders, and many other utensils may serve as carriers. In a large proportion of cases, especially of the extragenital infections, mediate contagion occurs, and the infection has nothing to do with sexual intercourse at all. During sexual congress individuals come most frequently and most intimately into personal contact. This occasions most inoculations to occur on the genitals, and it is this circumstance alone which gives syphilis any title to be called a venereal dis-

ease. It has been held in the past that a solution of continuity of the skin or mucosa in the person infected was necessary for the implantation of the virus; there seems to be some question now whether that is really the case, for Neisser has seen infection occur through an apparently unbroken integument. It is possible, however, that lesions too minute to be macroscopically recognizable may suffice for the entrance of the virus; it is certain also that in quite a considerable proportion of cases there is a distinct history of a lesion of some kind at the time of infection.

I am of opinion that the number of infections in doctors and nurses would be much greater than it is if a lesion of some kind on the recipient were not a necessary condition for infection under ordinary circumstances.

Certain occupations in which instruments or utensils are used in common, or upon various persons, are notorious sources of specific contagion; and there are many examples in medical history of epidemics of the disease occasioned in this way. The classical instances of the glass-blowers, where a common blow tube is passed from hand to hand; the histories of numerous syphilis infections in the practice of a physician, dentist, or midwife, and the epidemics of vaccinal syphilis that have been recorded need but be mentioned here. Most of these have been due to a neglect of the ordinary rules of cleanliness, not to speak of asepsis, and would hardly seem to need mention at the present day. Epidemics of vaccinal syphilis were bound to occur at intervals in the days when direct arm-to-arm inoculation was practiced; for the symptoms of heredosyphilis especially are often obscure or delayed, and mistakes were inevitably made sooner or later in a procedure so generally employed by practitioners of varying experience. At the present day, when animal lymph only is employed, there are no more of these unfortunate occurrences. Our knowledge of animal syphilis is, it is true, increasing by leaps and bounds, and it would be venturesome to say that the bovine race is entirely insusceptible to lues; so far as our present knowledge goes, this is apparently the fact; and we can safely affirm that, if they are susceptible to syphilis, it is in so attenuated a form as not to be dangerous to the human race.

Personal Prophylaxis.—The most efficient prophylaxis of syphilis, of course, is the avoidance of contagion; and since the main source of contagion is the sexual act abstention from it removes most of the danger of infection with the disease. It is good advice to give our patients, though but few will follow it. In our large cities, at all events, it is the rare exception for the young male adult to be continent; and even marital continence in older men is not the rule. The sexual impulse is, as a rule, entirely too strong to be governed by considerations of prudence as to personal infection. Under these circumstances the physician may consider it his duty on occasion to undertake the office of moral mentor; but I also

consider it his duty to inform his patients of the means of avoiding infection when exposed.

That there are such means is evident from the paucity of infections as compared with the immense frequency of exposures. The Magdeburg experiments show conclusively that every public woman has become infected by the time she has been two years on the town. Of course, a number of concomitant factors must be present for her to transfer the disease to her partner; she must have active lesions, and probably the conditions for infection of the male must include some lesion, however minute, of his skin or mucosa. Admitting all this, a single infected prostitute might infect multitudes of men if every act of intercourse with her resulted in inoculation of the disease.

The chief factor in preventing infection is undoubtedly cleanliness. This is a matter of business with the public woman, and largely accounts for the fact that as many or more infections are occasioned by what is known as clandestine prostitution or intercourse with nonprostitutes than by commerce with prostitutes themselves. Personal cleanliness on the part of the male is also undoubtedly efficacious, and this also is much more likely to be thoroughly carried out under the conditions of public prostitution than any other. It certainly takes an appreciable time for the spirochete to effect an entrance into the lymphatics; it is deposited on the surface at first, and while there can be washed away or destroyed. Personal cleanliness (*vide Hygiene*) is a measure that is entirely within the province of the physician to advise. Other precautions that may be used after a suspicious intercourse are the destruction with the thermocautery or with nitric acid of any lesions or solutions of continuity that may have occurred. Ablation of the chancre itself or of any suspicious lesion some time after the intercourse is a prophylactic measure of such importance that it will receive consideration in a separate section below.

In this connection reference may be made to a prophylactic measure suggested by Metchnikoff and Roux on the basis of their experimental work on monkeys; it is easily employed, painless, and harmless. A 30 or 50 per cent. calomel ointment, or a strong mercurial salve, is to be thoroughly inuncted into the infected or suspected area for ten or fifteen minutes; a 2 or 3 per 1,000 sublimate solution has been found by Neisser to be equally efficacious. Both of these have apparently prevented infection in animals after inoculation, and in one instance at least after a human experimental inoculation. It is only fair to state, however, that some eminent authorities, and notably Gaucher, have denied the efficacy of these procedures altogether; and it is naturally very difficult to determine the efficacy of any prophylactic measure at all; most cases will escape infection anyway. But the measure is so simple and rational that I advise it; the inhibitive effect of mercury on spirochete multiplication has been proven, and its local application can do nothing but good.

With any suspicious genital lesion, therefore, where ablation is not admissible, I first use the galvanocautery as thoroughly as possible and then dress the part with a calomel ointment.

Public Prophylaxis.—It is not my intention here to enlarge upon the general aspects of this much debated question, but rather to specify the main considerations which present themselves to the physician when confronted with a case that may be a source of danger to the people around him.

The surroundings of an infected individual must be protected as far as possible; and here we are necessarily governed by individual circumstances in each case, and can lay down few general rules. One thing I always insist upon, if the patient lives at home or in a family, is that one person in authority at least, and if possible the head of the family, must be informed of the patient's condition, of the dangers that it involves to those around him, and of the necessary precautionary measures that must be taken. These latter, especially in the earlier and more dangerously contagious stages of the disease, are so complicated and manifold that they will never be efficiently carried out unless those in authority in the household are aware of their urgent necessity. The wife must be informed if the husband has been infected, the father or mother if the misfortune has happened to the son. The alternative is to leave the home under some pretext or other. Of course we at once encounter the real or assumed necessity for profound secrecy about this, the most carefully concealed of diseases; and we have no real authority, other than a moral one, to enforce our decision. Ultimately the patient must do as he sees fit, and unfortunately it sometimes happens that carelessness or selfish considerations result in a course that occasions untold havoc. But the physician's duty is plain.

The infected person must not only avoid all personal contact, such as that involved in the acts of intercourse, fondling, kissing, etc., but he should sleep alone, in a separate room if possible, and should have his own separate toilet and table utensils. These should be separately cleansed after a preliminary soaking in lysol or other antiseptic solutions. His linen, especially such of it as is liable to be contaminated with his excretions, as towels, table napkins, and handkerchiefs, should be thoroughly boiled before being washed. The multiplicity and severity of these precautionary measures may vary, of course, with the conditions. Even an infected patient is dangerous only when he has lesions; and if he is under continuous medical observation the periods when he is really dangerous to his surroundings may be short and limited. Dry lesions on the surface of the body are not infective; nor are internal lesions that do not communicate with the surface; nor are the natural secretions, as those of the mouth, when that cavity is free from disease. But, of course, this safety is only immediate; an irritated dry lesion may be quickly transformed into a moist one, and mucous patches may appear overnight.

An important item under this heading relates to the occurrence of syphilis in wet-nursing, both as relates to the foster mother and the child. There are innumerable instances on record, both of heredosyphilitic infants infecting their nurses and of contaminated nurses transmitting the disease to their charges. A grave responsibility rests on the practitioner

in every case when he is called upon to make such a selection. A thorough examination of the woman should be made, both of the skin and the mucosæ of the various body cavities, and also of the glands; her history as to previous illnesses, abortions, etc., may be of value; and a Wassermann blood test should be insisted on if possible. Conversely, a syphilitic child must, under no circumstances, be nursed by a healthy woman; the bottle is the only resource if the mother cannot nourish the child. For, even if an infected wet-nurse were available, the child's chances on the kind of nourishment that she would supply would be poor. I have once or twice made an exception to this rule with good results when the conditions were such that the wet-nurse could be effectively treated, and, through her, the child receive medication as well.

Something has already been said in preceding paragraphs regarding the dangers of syphilitic infection incidental to certain callings. Few of these, however, entail the common use of tools or instruments that are liable to be brought into contact with mucous membranes, which are much more delicate and susceptible to injury than the skin. Dentists, nurses, hospital attendants, and physicians are naturally more exposed to danger than others, and unfortunately infections have frequently occurred. The hygienic measures described above are precautions that will naturally suggest themselves. Accidental lesions acquired during the manipulation of an infected or even suspicious case; or the discovery of any crack, fissure, or hangnail which might have afforded a point of entrance for the virus call for a thorough cauterization of the lesion. I always use nitric acid or the actual cautery. A knitting or darning needle heated in the alcohol flame affords a ready and efficient cauterizing instrument when no other is available; and a mercurial dressing may be applied afterward. The use of tincture of iodine for the purpose has been recommended by Nicolas, but I do not consider it as reliable as the other measures.

The vexed subject of public syphilis prophylaxis may be briefly referred to. The so-called Continental system, with the registration and regular examination of all public women, and with the detention under treatment of all those infected, has been tried for many years in a number of European cities, and has not, so far as I can learn, proved to be a marked success. I have not seen it claimed that luetic infections are decreasing in number, or that they are less in proportion to the population than they are in the American or English cities where the system is not used. They imply, moreover, a degree of interference with individual liberty that is repugnant to us. We may finally come to the Continental method; but we shall have to be convinced of its efficacy in a very different manner than has heretofore been the case.

Finally, a word as to the educational prophylaxis which has so many earnest advocates. I am heartily in favor of it, though alive to its disadvantages. It is not necessary to enforce the fear of syphilis upon the

lay mind; that is already present in more than sufficient amount. In so far as it teaches the recognition of the commoner signs and modes of infection, and the means of avoiding the latter, it deserves our hearty commendation and support.

Marital Prophylaxis.—This phase of the subject presents special difficulties. All the measures detailed under the headings of personal and social prophylaxis must, of course, be observed with extra rigidity when one partner is infected and the other is not. And then come the questions of the resumption of marital intercourse and the procreation of children. I lay down certain rules to my patients; sometimes they are followed and sometimes not; and, in either case, the healthy partner escapes infection sometimes, and sometimes does not. The ultimate responsibility, of course, rests with the patient himself.

1. Marital intercourse is entirely forbidden during the early and more dangerously infective stages of the disease, generally lasting, at least, the first year.

2. When resumed a condom should be habitually used and antiseptic lavage should be freely employed by both parties after the act.

3. Procreation is allowable only after there is a reasonable certainty of cure; and a prophylactic course of treatment should always be administered to the mother when conception has occurred, no matter how old the date of the infection.

The Abortive Treatment of Syphilis.—It was long the general opinion that all attempts at the abortion of the disease were useless, and that the practitioner should wait, in a suspected case, until indubitable signs of the disease appeared. But we now possess earlier means of recognition of the nature of a lesion in the microscopic detection of the infecting agent, and in the blood-serum tests. It is my firm belief that some cases of syphilis, at all events, are aborted; for any one with an extended experience with the disease must recall cases in which there was undoubted evidence of early infection which was never followed by further signs of sickness. Besides this, the patient demands immediate treatment, even if the diagnosis is not absolutely established in the practitioner's mind; and there is no reason to doubt that early and effective treatment, even if it does not abort the disease, may shorten its course and mitigate its symptoms. In this connection the new arsenobenzol injection treatment is at present of great interest; it will be fully described and discussed later, under its own heading. Suffice it to say here that I have seen no evidence to show that it has the slightest power greater than that of mercury to abort an infection. As a matter of fact, it is my impression from the observation of a large number of cases that symptoms of persisting infection, misleadingly called "relapses" by the Continental writers, occur sooner after "Salvarsan" than after efficient mercurial medication. I advise, then, a thorough and most vigorous local and general mercurial treatment, possibly with the addition of arsenobenzol, as soon as there

is reason to believe that a syphilitic infection exists. Once in a long while we will meet with a case that shows no further symptoms of the disease; but, small as the chance is, it is our duty to give the patient the benefit of its possibility. It is different, however, with the next abortive measure that I shall discuss, which is of greater promise.

Chancre Excision.—This measure was extensively experimented with many years ago and with results so unsatisfactory that it has come to be regarded as axiomatic that it was useless to attempt to influence the course of the disease in this way. Even the most recent text-books generally condemn it and still refer to the experiences of those who tried it half a century ago and who found that excision, no matter how radical, was always followed by induration of the scar and appearance of the secondary symptoms. Mauriac, Kaposi, and Fournier are their authorities for rejecting excision as a perfectly useless mutilation. Insufficient note was taken of the facts that, in those days, the diagnosis was necessarily made late, after systemic infection had occurred, and that modern methods to prevent infection of the wound were probably not employed. Many writers, in fact, went so far as to regard the results of excision as of value from a diagnostic point of view; if the patient had syphilis subsequent to the operation the lesion had been a chancre; if he did not there had been no infection at all. Nor was any note taken of the fact that a therapeutic measure may not be completely abortive of the disease and yet may have an important influence on its extent and severity. Some writers, however, and I am glad to class myself with them, have always held that there was a field and a use for excision in the scheme of the luetic treatment.

The discoveries and experiments of the last few years have altered matters to such an extent that even the most conservative must admit that the entire subject of chancre excision needs renewed study and investigation. The discovery of the infecting organism and the elaboration of ready means of detecting its presence have entirely changed the question of diagnosis, which may now be made with precision at the very earliest stages of a suspicious lesion, without waiting for the confirmatory secondary signs. The nature of the minutest papule or fissure can be determined. Lesions can be excised days and weeks earlier than would have been justifiable before; and the operation can readily be done in tissue so healthy and with such precautions as to avoid all danger of operative reinfection. Theoretical considerations also necessarily lead us to the conclusion that there must be a time when the infection is still purely local. From the nature of things the organism is implanted on or near the surface of the tissue. For the same reason it takes an appreciable time to grow and multiply and penetrate the lymphatics. This time may be long or short, but it cannot be instantaneous; and thus it merely becomes a question as to how late after an inoculation excision can be successfully practiced. I have seen cases with a penile abrasion within an hour after a suspicious intercourse; and it is beyond reason to suppose that excision would not have removed all the infective material.

Nor are there experimental data wanting to confirm these conclusions. The discovery of the susceptibility of apes to the disease has given opportunity for this work; and Neisser has repeatedly practiced inoculation in these animals, followed, after varying intervals, by excision, and has aborted the disease successfully. The time limit after inoculation when it can be successfully accomplished has not yet been fixed. Some of the best authorities, including Neumann and Matzenauer, report that they have absolutely aborted the disease in the human subject by this means; and Sibut, in his recent collection of the latest statistics of excision, shows no less than 5 per cent. of complete successes. Nicolas, among others, also advocates the procedure warmly. I have had no personal experience with excision recently; but I have practiced it a number of times in years gone by, not so much with the hope of aborting the disease (for all experience seemed against it) as for the purpose of relieving the patient of a distressing and disgusting lesion, and removing a large infective focus from his body. Most of the half dozen cases in which I employed the procedure could not be followed very long. In others secondary phenomena appeared in due time; but in one case I firmly believe that I succeeded in aborting the disease. The nature of the infection was undoubted; for not only was the lesion on the rather redundant remains of the prepuce clinically typical, but the specimen has been ever since the most perfect chancre microscopically in my laboratory. It was one week old when ablated under cocain; there was primary union and no subsequent induration. The patient was under observation for more than a year thereafter, and never showed any signs of systemic infection.

We have some few data now, also, as to the effects of chancre excision even where abortion is not successful. Neumann and Matzenauer, for instance, reported that in every excised case there was a marked diminution in the intensity of the infection, and Sibut reports 16.5 per cent. of attenuations from the measure. This alone would be a justification for this minor surgical operation in suitable cases.

The operation can only be done, of course, when the lesion is situated on a part where there is plenty of loose, flexible skin, as on the prepuce or shaft of the penis, the nymphæ, etc.; it should not be attempted when it is on the glans or at the orifice of the urethra, where primary union is difficult to obtain, hemorrhage is liable to be excessive, and the necessary mutilation is great. A regular circumcision is advisable when the lesion is on the prepuce.

In all cases I use a clamp to isolate the lesion completely from the surrounding tissue and then, with a pair of curved scissors or a curved bistoury, remove the entire tumor with its surrounding tissue. Cocain anesthesia is not advisable on account of the danger of infection of the needle punctures; freezing is better; and, if thoroughly done, gives a solid frozen mass which includes not only the tumor but the neighboring integument and tissues as well. Of course all the skin

near the incision line must be thoroughly cleaned and sterilized and the greatest care must be taken to prevent infection during or after the operation. The suturing should be done with the finest possible silk, the stitches being removed four to five days later. A weak wet bichlorid or a dry antiseptic dressing is appropriate.

TREATMENT

THE WASSERMANN REACTION

It is not my intention here to discuss the symptomatology of syphilis; this would be out of place in a work devoted to therapeutics alone. In so far as the symptoms are of importance in determining the kind, intensity, and duration of the medication advised, they will receive such consideration as they require under a later heading, when I discuss the general plan of specific medication. One symptom, however, requires especial consideration, not only because it is a new one, but also because its actual significance is still not entirely determined, and misconceptions as to its meaning may readily arise. I refer to the blood-serum test discovered by Wassermann and elaborated by Noguchi and others. Can we accept the test as an indication for treatment?

The general opinion seems to be that we can, and there is a marked tendency to rely upon it to the practical exclusion of other indications. I am firmly convinced that this is a mistake. In spite of the innumerable observations showing its reliability, it has its limitations, which those most conversant with it are the freest to admit. In the first place, in a complicated reaction, which varies in intensity from a most marked one to one that is barely recognizable, much depends on the personal equation. It must be made by an expert thoroughly conversant with the technique and with the resources of a well-equipped laboratory at his disposal. In the second place, while a positive test by a competent hand, especially if repeated, means much, a negative result means much less; even if repeated many times, it means nothing at all in the face of other indubitable symptoms. I should not hesitate a moment, for instance, in diagnosing a mucous patch as syphilis, no matter what the patient's Wassermann reaction was. For we know that, while there are a few rare conditions other than syphilis which give a positive agglutination reaction, there are some common ones that render it negative, even when the disease is present; the commonest of these being the previous exhibition of mercury in some form. Yet nothing but syphilis causes a typical mucous patch. I have seen repeated cases in which the evidences of syphilis were unmistakable, and yet the serum reaction was negative. On the other hand it must never be forgotten that undeniable serological evidence of constitutional syphilis does not necessarily mean that the disease under consideration is luetic; a patient may suffer from other things while he has syphilis.

The blood-serum test for syphilis is, therefore, merely a symptom of the disease; it is characteristic but not pathognomonic, as some of the other symptoms are; it may on occasion be fallacious; and it is to be considered in conjunction with the other features of the case in question. It is of extreme value because it can be elicited when other symptoms are in abeyance, or have not yet appeared. The question of immediate interest to us here is its status as an index and guide to treatment. The conclusions to which I have come are as follows:

a. The Wassermann serum test is the necessary second symptom of syphilis required in doubtful cases; or it may serve to confirm an established diagnosis, and indicate the necessity for treatment.

b. Its presence alone, without any other symptoms, is to be regarded as indicative of the necessity for treatment, though not urgently.

c. In a case that has been under treatment, and which is otherwise clinically cured, a persistent positive Wassermann reaction means, for a time at least, the necessity for further treatment.

d. A positive Wassermann reaction does not necessarily mean that the condition under consideration is syphilitic.

e. A single negative Wassermann test means little; but if repeatedly negative at longer intervals, with no other signs of infection appearing, it may be taken as an index of cure, and authorizes us to stop treatment.

THE SPECIFIC MEDICATION

Of all the multitudinous drugs and remedial procedures which have, in the course of time, been recommended to combat the syphilitic infection but three have stood the test: mercury, iodine, and arsenic remain with us, while all the other mineral and vegetable preparations have sunk into innocuous desuetude. Fortunately for the human race these three powerful drugs have proved so effective that our control over the luetic disease phenomena is such as to have few parallels in therapeutics; so that they are commonly designated the specific medication, and the term has even been transferred to the disease in question itself. The two first stand pre-eminent and impregnable, fortified by daily results and the experience of centuries. Arsenic, while by no means new in syphilotherapy, has long been neglected; but in its newest organic forms it has excited so general an interest and is at the present moment so widely used that it merits separate consideration. Brief mention will also be made of the other subsidiary and occasionally useful medication.

Mercury

In spite of misuse and consequent abuse, mercury has been and remains our chief therapeutic weapon to combat the syphilitic infection. Its

curative effect on the disease phenomena has been universally recognized since it was first employed in the fifteenth century; and while there have been reactions against it and all manner of troubles, including the belief that the results of the disease itself have been caused by it, it maintains its place as the remedy par excellence for syphilis, hereditary or acquired, from its very earliest to its very latest stages. Other remedies come and go, but mercury remains our sheet anchor. A detailed exposition of its actions and effects and of the most effective modern methods of employing it will form the main part of our considerations.

The Action of Mercury in Syphilis.—Many years before the discovery of the spirochete it was evident and was taught that some living microorganism was the cause of the disease, and that mercury evidently acted as a parasiticide. It hindered its growth when it had obtained lodgment in the body, so that existent lesions disappeared under the natural reparative body processes, and it evidently prevented the development of new disease foci. So marked was its action that it was occasionally possible to effect almost marvelous cures of lesions; and it was even usual, by its judicious and consistent administration, to so modify and mitigate the disease that the ordinary sequence of infection phenomena became very light or even did not appear at all. Every practitioner of experience has seen cases of syphilis which, under treatment, have shown a mild and fugacious roseola, or a few evanescent mucous patches, as the only evidences of the secondary stage of the disease; and, in a large proportion of the treated cases, tertiary symptoms were entirely wanting. Some of this may be due to the fact that syphilis, as we see it to-day, is undeniably a milder disease than it was in years gone by; and there can be no doubt at all that its main cause is the more extensive and effective mercurial treatment which is now generally employed.

I cannot say that the discovery and establishment of the *treponema pallida* as the active infective agent in syphilis has advanced our knowledge of the precise action of the specific drug to any great extent. Levy-Bing has established its direct parasitic action on the microorganism; but it is difficult to understand this effect when we remember the very minute proportion of the drug that can possibly be present in any given body fluid or tissue at any one time. It is well known, of course, that it is difficult or impossible to demonstrate the specific organism in any lesion which has been subjected to local mercurial medication; and that general mercurial treatment, even in small amount, may render the serum reaction negative, even when manifest signs of active disease are present; the latter being the only explanation that the serologists can offer when an evident case does not give the expected result. All that we can say at the present time on the subject is that a direct bactericidal action, or at all events an action interfering with microbic growth, seems to be the way in which the drug acts in the disease.

Absorption of the Mercury.—Many theories have been advanced as to the manner of absorption of the drug since the time when Hunter, Mialhe, Overbeck, and others claimed that, in whatever form it was administered, it did its work in the form of an organic chlorid or oxy-chlorid circulating in the blood. Merget and Blarez, failing to find any chemical evidences of this fact, held that the salts were reduced, and that the metal itself united with the hemoglobin to form an insoluble precipitate. The latest authorities, such as Nicolas, still hold that it is in the metallic form proper that the drug exerts its action; and Collet claims to have actually seen the leukocytes absorbing the metallic particles.

In direct opposition to these largely theoretical considerations is the undoubted fact that the efficacy of a given mercurial preparation does not vary directly with the quantity of the metal which it contains. Thus gray oil is much less active than calomel, though approximately equal to it in mercurial content. It seems probable that Emery's contention is correct, and that many factors enter into the question of mercurial absorption within the body: the precise acid or radicle associated with the mercury, the molecular arrangement of the compound, its rapidity of absorption, its facility of reduction, and its toleration by the organism. We shall have abundant evidence of the differences in action of the various preparations administered in different ways later on.

Elimination of the Mercury.—Mercurial elimination takes place by all the emunctories, but, in the first place, most abundantly and earliest by the liver and kidneys. It appears first in the urine, the time being determined by the preparation used and the method of its administration. Thus Nicolas and Lheureux found it in the urine one hour after an injection of the biniodid, and only three to twelve hours after inunctions; Carle and Boulud demonstrated it three to twenty-four hours after pill ingestion. Still later it has been found in the saliva, the milk, the sweat, the bile, the feces, and even in the tears and the pus from an abscess. Elimination reaches its apogee after a time, and continued administration thereafter undoubtedly leads to accumulation of the drug in the system. It would be well if we had some ready and practical method of watching and estimating the process through the urine; but all the various processes recommended, including the latest ones of Merget and of Nicolas and Lheureux, are too complicated for general use.

The duration of elimination varies greatly with the mercurial employed, the method of its elimination, and even the individual peculiarities of the patient. This explains the great differences of opinion on this subject on the part of various investigators. Thus, a single biniodid injection may give mercury in the urine one to three hours later, the maximum excretion lasting twelve to eighteen hours, and the drug being still demonstrable two to five days later. Some authorities claim to have found mercury in the excretions many weeks and months after its administration

has ceased, but their conclusions cannot be accepted without question. The persistence of mercury in the organism, however, serves in part to explain its usefulness in a chronic infection where the organisms and poisons to be combated may be in the remotest parts of the body and entrenched behind ramparts of occluded vessels. It also gives theoretical validity to the clinically ascertained benefit of a chronic intermittent form of treatment as opposed to attempts to destroy all the virus in the system at one blow.

Hydrargyrism.—Mercury is a powerful weapon in the treatment of the luetic infection, and under circumstances may be a dangerous one. Serious damage and even death may be occasioned by its careless employment. It is true that it is only in very exceptional cases that accidents occur; and even these can be avoided by caution and a proper employment of the remedy.

Idiosyncrasy.—In extremely rare instances—I have met with but two or three in the course of an extended experience with the drug—mercury cannot be borne at all; even the smallest amount of it, externally or internally, causing a general and cutaneous reaction of a violently explosive type. Some years ago I encountered a case of malignant syphilis in which the very smallest dose of gray powder or calomel internally, or an application of white precipitate ointment externally, caused a most intense general pustular dermatitis, with nausea and vomiting, bloody diarrhea, and collapse. As a matter of precaution then, and it is a rule that I almost invariably follow both in private and public practice, a new case that has never had mercurial treatment before receives a small initial dose. The only exception to this is in emergencies when the immediate and full therapeutic action of the drug is required. Besides these very exceptional cases, mercurial hypersaturation shows itself in the following ways:

General Intoxication.—A too prolonged administration of the drug occasions a toxic chloroanemia shown by general lassitude, insomnia, loss of weight, and even cachexia, that may be readily confounded with the similar condition incident to early syphilitic poisoning or extensive late lesions complicated with secondary infections. The differentiation between the two is not easy to make, save by watching the results of treatment. Every once in a while there comes into my wards at the City Hospital a patient in a deplorable general condition, emaciated, bedridden, covered with ulcerative gummata, or with bone or internal syphilis. Sometimes this patient is suffering from syphilis and septic infection, and then mercury and other antisiphilitic remedies act like a charm; all the symptoms improve rapidly, and the drug properly administered not only cures the symptoms of active disease, but is an absolute tonic and reconstituent. But sometimes the patient has had vigorous treatment before, and gets progressively worse under mercury, iodine, or arsenic. Stop all internal medication for such a patient, save mild local measures; have him out in the

Absorption of the Mercury.—Many theories have been advanced as to the manner of absorption of the drug since the time when Hunter, Mialhe, Overbeck, and others claimed that, in whatever form it was administered, it did its work in the form of an organic chlorid or oxy-chlorid circulating in the blood. Merget and Blarez, failing to find any chemical evidences of this fact, held that the salts were reduced, and that the metal itself united with the hemoglobin to form an insoluble precipitate. The latest authorities, such as Nicolas, still hold that it is in the metallic form proper that the drug exerts its action; and Collet claims to have actually seen the leukocytes absorbing the metallic particles.

In direct opposition to these largely theoretical considerations is the undoubted fact that the efficacy of a given mercurial preparation does not vary directly with the quantity of the metal which it contains. Thus gray oil is much less active than calomel, though approximately equal to it in mercurial content. It seems probable that Emery's contention is correct, and that many factors enter into the question of mercurial absorption within the body: the precise acid or radicle associated with the mercury, the molecular arrangement of the compound, its rapidity of absorption, its facility of reduction, and its toleration by the organism. We shall have abundant evidence of the differences in action of the various preparations administered in different ways later on.

Elimination of the Mercury.—Mercurial elimination takes place by all the emunctories, but, in the first place, most abundantly and earliest by the liver and kidneys. It appears first in the urine, the time being determined by the preparation used and the method of its administration. Thus Nicolas and Lheureux found it in the urine one hour after an injection of the biniodid, and only three to twelve hours after inunctions; Carle and Boulud demonstrated it three to twenty-four hours after pill ingestion. Still later it has been found in the saliva, the milk, the sweat, the bile, the feces, and even in the tears and the pus from an abscess. Elimination reaches its apogee after a time, and continued administration thereafter undoubtedly leads to accumulation of the drug in the system. It would be well if we had some ready and practical method of watching and estimating the process through the urine; but all the various processes recommended, including the latest ones of Merget and of Nicolas and Lheureux, are too complicated for general use.

The duration of elimination varies greatly with the mercurial employed, the method of its elimination, and even the individual peculiarities of the patient. This explains the great differences of opinion on this subject on the part of various investigators. Thus, a single biniodid injection may give mercury in the urine one to three hours later, the maximum excretion lasting twelve to eighteen hours, and the drug being still demonstrable two to five days later. Some authorities claim to have found mercury in the excretions many weeks and months after its administration

has ceased, but their conclusions cannot be accepted without question. The persistence of mercury in the organism, however, serves in part to explain its usefulness in a chronic infection where the organisms and poisons to be combated may be in the remotest parts of the body and entrenched behind ramparts of occluded vessels. It also gives theoretical validity to the clinically ascertained benefit of a chronic intermittent form of treatment as opposed to attempts to destroy all the virus in the system at one blow.

Hydrargyris.—Mercury is a powerful weapon in the treatment of the luetic infection, and under circumstances may be a dangerous one. Serious damage and even death may be occasioned by its careless employment. It is true that it is only in very exceptional cases that accidents occur; and even these can be avoided by caution and a proper employment of the remedy.

Idiosyncrasy.—In extremely rare instances—I have met with but two or three in the course of an extended experience with the drug—mercury cannot be borne at all; even the smallest amount of it, externally or internally, causing a general and cutaneous reaction of a violently explosive type. Some years ago I encountered a case of malignant syphilis in which the very smallest dose of gray powder or calomel internally, or an application of white precipitate ointment externally, caused a most intense general pustular dermatitis, with nausea and vomiting, bloody diarrhea, and collapse. As a matter of precaution then, and it is a rule that I almost invariably follow both in private and public practice, a new case that has never had mercurial treatment before receives a small initial dose. The only exception to this is in emergencies when the immediate and full therapeutic action of the drug is required. Besides these very exceptional cases, mercurial hypersaturation shows itself in the following ways:

General Intoxication.—A too prolonged administration of the drug occasions a toxic chloroanemia shown by general lassitude, insomnia, loss of weight, and even cachexia, that may be readily confounded with the similar condition incident to early syphilitic poisoning or extensive late lesions complicated with secondary infections. The differentiation between the two is not easy to make, save by watching the results of treatment. Every once in a while there comes into my wards at the City Hospital a patient in a deplorable general condition, emaciated, bedridden, covered with ulcerative gummata, or with bone or internal syphilis. Sometimes this patient is suffering from syphilis and septic infection, and then mercury and other antisyphilitic remedies act like a charm; all the symptoms improve rapidly, and the drug properly administered not only cures the symptoms of active disease, but is an absolute tonic and reconstituent. But sometimes the patient has had vigorous treatment before, and gets progressively worse under mercury, iodine, or arsenic. Stop all internal medication for such a patient, save mild local measures; have him out in the

sunlight daily for as long as possible, or put his bed where he can have plenty of light and air; give him as much milk and the most nutritious diet possible; and behold! improvement starts in at once and progresses rapidly. I have seen such patients with most extensive tertiary ulcerations have every one healed in a month under nothing but a simple boric acid wet dressing, and gain weight at the rate of a pound a day. They are suffering from chronic hydrargyrisms rather than from syphilis.

Mention may also be made here of neuritis, a rare affection; optic neuritis is of especial interest to-day, in view of the fact that it is a recognized occasional happening under the intensive arsenical medication so much in vogue. I can only say that I have never seen a case occasioned by mercury.

Buccal Accidents—Mercurial Stomatitis—Salivation.—"Touching the gums," as it used to be called, is no longer regarded as necessary in mercurial medication, and any mercurial action on the gums or mouth is a sign for the diminution or temporary cessation of the mercurial treatment. The mouth symptoms may vary from a simple salivation with very slight swelling of the gums to a well-developed general stomatitis with an abundant flow of fetid saliva. I have encountered a few times a gangrenous and necrotic stomatitis, in one case with necrosis of the inferior maxilla; and I can recall one case that ended fatally from sepsis occasioned in this way. These extremely rare accidents should never occur when the drug is administered in the proper manner and under efficient supervision.

Cutaneous Accidents.—These may be occasioned by the local employment of the drug, as in the folliculitis caused by mercurial ointment, and the simple, scarlatiniform, or even pemphigoid erythema due to the use of other mercurial applications. The severer forms of skin lesions are generally caused by the internal administration of the drug, and are accompanied by signs of general disturbance, anorexia, vomiting, fever, diarrhea, headache, delirium, etc. Occasionally the eruption is polymorphous, and it then resembles a multifiform erythema.

Gastrointestinal Accidents.—These occur most commonly when the drug is administered by the mouth, but are occasionally seen when it is given by other methods. Gastralgia, nausea and vomiting, diarrhea, and dysentery may occur; and cases of gangrenous enteritis with fatal termination have been recorded. Certain preparations are much more prone to occasion them than others; the bichlorid administered per os being especially so.

Renal Accidents.—The kidney being the main organ of excretion for the drug, it is not to be wondered at that it should sometimes suffer from its effects. The mercurial albuminuria is usually mild and catarrhal in type, and is difficult to distinguish, like the cachexia, from the nephritis occasioned by the syphilis itself. The only safe rule is to watch the

kidneys during a course of mercurial treatment, and to modify or suspend it when these organs show any signs of special susceptibility.

The Prevention and Treatment of Hydrargyris.—Practically all the accidents of hydrargyris are avoidable; even in the rare cases of idiosyncrasy to the drug, caution in its first exhibition prevents any serious effects. As regards the mouth, where the first effects of supersaturation are usually seen, the reader is first referred to the section preceding on Hygiene of the Syphilitic; the care of that cavity being the main element in preventing mercurial trouble there. A mild hydrogen peroxid gargle may be used after it as a matter of toilet routine; it has both a preventive and a curative action as regards mouth lesions.

Mild stomatitis may be treated by the above measures, with the addition of daily applications of tincture of iodine, 1:10, chromic acid, etc. Severer cases do well, strange to say, with sublimate mouth washes, 1:10,000 to 1:6,000, or $\frac{1}{2}$ to 1 per cent. silver nitrate applications, or stronger chromic acid solutions. When the mouth is badly affected, cocaine or eucaine solutions, $\frac{1}{2}$ to 1 per cent., may be required to relieve pain and to enable the patient to take food. (See also the chapter on Diseases of the Mouth.)

When the kidneys are affected and it is decided that the mercury and not the infection is its cause it may be possible, by reducing the dose or varying the preparation, to continue its administration without damage to those organs. Insoluble injections and inunctions are especially to be avoided under these circumstances, and a mild mouth medication, as with the tannate of mercury, or soluble injections, that are rapidly eliminated and can be minutely varied, are to be preferred. It goes without saying that in every case of marked mercurialism the administration of the drug must be greatly reduced or entirely suspended for the time being.

Mercurial Preparations and Their Administration.—Under this heading I shall consider very briefly the chief forms under which the drug is employed, and the various methods of its administration; devoting my attention chiefly to those that I have found most useful and habitually employ and advocate. The experience of years has convinced me that the drug is often used inefficiently, both in form, amount, and method of exhibition. So great is the difference in results between mercury employed in the usual form of the so-called "mixed treatment," or pill, and the same drug when used by injection, that we would almost seem to be dealing with two different remedies. I shall say but little about the older methods, devoting my chief attention to those that have proven most efficacious in my own experience, and that now, I am glad to say, command the approbation of the most advanced syphilographers the world over.

ADMINISTRATION BY MOUTH.—This is naturally the oldest and by far the commonest method of exhibiting the drug, and it certainly has

some *prima facie* advantages. It is easy, necessitating merely the writing of a prescription; it is cleanly, and it is in the form in which patients are accustomed to receive medical treatment.

But there are certain very manifest disadvantages which have gradually led to its practical abandonment as a routine method of syphilis treatment by experts. Medication by ingestion is slow, and there is sometimes need of haste from a medical viewpoint, and always need of it from that of the patient. It is uncertain, inasmuch as the mere administration of a certain dose is no guarantee of its absorption. We have no means of telling how much of it reaches the patient's blood and how much passes out unabsorbed. The entire stress of absorption is put on the alimentary canal; derangement of this organ is therefore a common sequel to the medication; and it should not be used at all in patients with gastrointestinal disorders. Salivation, gastralgia, enteritis, diarrhea, etc., frequently occur. The most important drawback of the method, however, is incidental to the fact that the medication must be administered several times a day, and by the patient himself. This means that, for long periods of time, he must take medicine surreptitiously and be exposed to the danger of detection; and it also means that we must rely on the patient's memory and attention during the long periods of apparent good health that are the rule with syphilis as we see it to-day. Finally, it puts the treatment in the patient's hands; he can take his dose or not take it, or take it irregularly, as he likes; he visits his physician when he sees fit; and the whole course of treatment is in the patient's hands, rather than in those of his attendant.

There are certain cases, however, in which I employ the ingestion method. Occasional very sensitive patients object to injection or similar medication; and sometimes it is well, especially in females, and in the intervals of more efficient medication, to use the digestive tract. Again a patient may be from a distance, which precludes the use of endermic medication; or he may be a traveler and unable to take injections with any regularity. A wise eclecticism is the only true rule; never forgetting, however, that our patients are entitled to the very best that we can possibly do for them.

The protoiodid of mercury, in doses of $1/5$ to $1/2$ grain, is probably the most commonly administered salt. It is powerful, containing 61 per cent. of the metal; but it is very liable to cause intestinal irritation and diarrhea. It is well, therefore, to combine it with 1-5 or 1-3 grain of powdered opium. Mercury with chalk in doses of 1 to 3 grains, or the tannate of mercury in $1/2$ to 1 grain doses, are appropriate forms of medication in cases where the protoiodid is not borne, or for children. Calomel should rarely be used in the regular treatment of syphilis, since it is extremely liable to cause stomatitis or enteritis when given for long periods.

Of the soluble mercurials, the bichlorid is very powerful, but also very

irritant. Except in the form of the so-called "mixed treatment," to be adverted to later, its use is not advised. The same may be said of the biniodid. If mercury alone is administered per os, the protoiodid or the tannate are the best preparations. I append two suitable recipes for their exhibition in pill form:

℞ Hydrarg. proto-iodidi, gr. x (0.6 gm.).
Pulv. opii, gr. x (0.6 gm.).
Extr. gent.,
Aquæ, āā p. ut ft. pil. no. l.

℞ Hydrarg. tannat., gr. xxv (gm. 1.6).
Adip. lanæ,
Sacch. lact., āā p. s. ut ft. pil. No. l.

One of these pills may be given two or three times daily; but, of course, the dosage depends upon the age and size of the patient, the urgency of the symptoms, the toleration of the mercurial medication, and other factors.

ADMINISTRATION BY THE RECTUM.—In an exceptional case, where injections cannot be used, where inunctions are rejected, and where gastrointestinal irritation precludes mouth medication, this method, advocated by Audry, may be tried. It would seem indicated where local rectal or anal lesions are present, combining both local and general treatment in one. Only the bland salts can be employed; I have used gray oil (40 per cent. of metallic mercury well rubbed up in oil) in the ordinary suppository in the proportion of 1-10th to 1 per cent. Rectal absorption under favorable circumstances is quite good; but the method is open to all the objections of the buccal one, besides being more troublesome and uncleanly. [Unguentum hydrargyri may also be administered in the form of suppositories.—Editor.]

ADMINISTRATION BY THE SKIN.—Under this heading I include inunction and fumigation, as well as the varieties of these methods that have from time to time been proposed. *Inunction* is the most important, for it still occupies, on the Continent, the place taken by the ingestion method in France, Germany, and America. The authority of the great German syphilographers of the last two generations is responsible for this; but the method has never found much favor here, and for very obvious reasons. All the objections as to uncertainty of dosage and relegation of the treatment into the patient's hands apply with even more force to this than to the commoner method. In fact, it is entirely uncertain how much of the medicament is absorbed through the skin. The most painstaking investigations have led to no definite conclusions on this point. In fact, it is held by some authorities that the inunction is really

an inhalation method; that, practiced under conditions which preclude the inhalation of the vaporized metal, as in the open air, or on the skin of a limb thrust through a partition into another room, there is very little mercurial absorption at all. These are serious objections enough; but there are others of even greater practical moment, especially in view of the fact that we have at our disposal modes of administration of the drug that avoid them. Inunctions are time consuming beyond all measure; $\frac{1}{2}$ to 1 hour daily at least must be devoted to the treatment; a point of great importance in our busy life, especially when they have to be done during periods when the patient is apparently well, and actively engaged with the business and pleasures of ordinary life. Inunctions are necessarily uncleanly to a degree that renders their employment very disagreeable to fastidious persons. Finally, and perhaps above all, inunctions are that form of treatment which can be least readily concealed; time must be spent daily in seclusion to administer it, and the inevitable staining of the skin, as well as the almost necessary soiling of the linen, makes it very difficult indeed for an inunction course to be given in secrecy.

Nevertheless, as with the mouth medication, which I have rejected as the regular treatment, there are cases in which it should be employed. It has the advantage of sparing the gastrointestinal tract, so that it can be advised where that route as well as injections are inadmissible. Some European patients absolutely demand it, and physicians of Continental training are largely prejudiced in its favor. Properly administered, it is certainly an effective form of medication, in spite of its uncertainties and drawbacks. I favor the Neapolitan ointment, made of equal parts of metallic mercury rubbed up with benzoinated lard, or a 10 to 25 per cent. suspension of the oleate of mercury in olive oil, rather than the official blue ointment. They are both of them less dirty and less telltale. The dose of the first is 1 or 2, of the other 2 to 4 drams, according to the age of the patient, the urgency of the symptoms, etc. After careful and thorough washing with warm water and soap of the part to be rubbed, the requisite amount of the preparation is carefully and thoroughly but gently rubbed into the skin until all trace of the medicament has disappeared. Parts of the body surface devoid of hair should be selected for the inunctions; on the hairy parts a troublesome folliculitis is almost certain to be set up, and very hirsute individuals cannot employ the method at all. By using, in rotation, the inner surface of the thighs, the flanks, and the upper arms, six surfaces for six successive inunctions can be gotten, and at least five days' rest is afforded to each skin surface before it is again called upon to submit to the friction. This rotation is important, since a certain amount of irritation is inevitably occasioned. The inunctions should be done in a closed warm room, preferably at night; at least fifteen minutes' time should be employed for one inunction. If the patient practices the inunction on himself, the naked hand may be used;

if it is done by a nurse or attendant, the latter should use a leather or rubber glove. From ten to forty inunctions, given every night or every other night, constitute the usual course.

Other Cutaneous Methods.—Under this heading I shall mention certain methods of mercurial medication through the skin that may be found useful in special cases.

Fumigation.—This still finds a place in our textbooks on *materia medica*, though it is almost obsolete on account of its troublesomeness and the liability to mercurial poisoning from its employment. It may still be useful, however, in certain cases, as when there are extensive ulcerative lesions around the genitals, the anus, or the legs. Local and general medication may thus be advantageously combined. The patient is seated on a stool chair or one with a perforated seat, with the lower part of his body exposed to the vapors and blankets tightly wrapped round his body and the chair. By means of a spirit lamp under a tripod on the floor under him, from $\frac{1}{2}$ to 1 dram of calomel on a plate is slowly vaporized, plenty of time being given for the slow disappearance of the drug and its deposition on the skin. In the City Hospital I formerly used the method occasionally; but I confess that I have not found any indication for its application in recent years.

Mercurial Baths.—This method finds a field in the mercurial treatment of infants; I habitually employ it in this class of patients for the following reasons: the infantile skin is much more absorptive than that of the adult; it is a combined local and internal treatment, when, as is so frequently the case, there are general dermal or genitoanal lesions present; and it entirely avoids all direct irritation of the infant's delicate gastrointestinal tract. Injections, of course, are not suitable for infants; their skin and muscles are entirely too delicate and tenuous; and for much the same reasons inunctions are undesirable. The baths are given in the following manner: Into a wooden wash tub (a metallic one must, of course, not be used) filled with warm water, 20 to 30 grains of bichlorid of mercury with an equal amount of ammonium chlorid dissolved in water are added. The child is allowed to remain for from ten to fifteen minutes immersed in the bath, care being, of course, taken of the hands and face so that none of the bath fluid reaches the mouth. The baths are to be given once daily as a rule; in certain cases every other day suffices.

Mercurial Plasters.—First advocated by Quinquaud, this method of general medicament is entirely too slow, uncertain, and inefficient for use in adults; but it finds a place in the therapeusis of infantile lues for the same reasons as mercurial baths do. The dosage needed is so small, and the infantile skin is so delicate and absorptive that an efficient antiluetic treatment is possible.

In fact, in heredosyphilis I usually combine the bath medication, outlined above, with the use of mercurial ointments or plasters; and I generally find these

fully efficient, without having to have recourse to the digestive tract. I prefer a mixture of the officinal white precipitate and mercurial ointments, in equal parts or in varying proportions, according to the necessities of the case, or a 5 to 20 per cent. lanolin ointment of the oleate of mercury. A quantity of this, say 60 grains, is spread on a piece of muslin and adjusted under the belly-band next to the skin. Signs of local irritation are the signal for a change in the locality of the application.

Mercurial Flannels, Mercolint Aprons, Etc.—A number of variations of the endermic method may be mentioned here for the sake of completeness. Welander's Mercolint Aprons are long, flat bags containing material impregnated with mercury to be worn on the chest next to the skin. As stated above, there is but little mercurial absorption by the skin; any good which these aprons do is effected by the inhalation of the vaporized drug. They may find a field of usefulness in isolated cases in default of other and more vigorous treatment. The same may be said of the mercurial pillows upon which Merget makes his patients sleep at night.

ADMINISTRATION BY INJECTION.—The reader has doubtless gathered from the foregoing that, while the various methods of administering mercury already considered have their uses and are to be employed in suitable cases, I do not advocate them for the regular and systematic treatment of the luetic infection. We have other methods of giving the drug that are so decidedly preferable to them as to almost constitute an independent therapeutic plan. I have for many years practiced and advocated the hypodermic plan of mercurial medication; and accumulated experience both with it and with other methods has only confirmed my prepossession in its favor. The leading syphilographers the world over agree in this to-day; and the general profession is ever more largely employing it. It is par excellence the modern method of treating syphilis.

The mercurial injection method of treating syphilis may be effected in two ways, leading to the division of the subject into two main headings; the difference between which is often imperfectly appreciated. Either a soluble or an insoluble salt may be injected. In the first case a soluble mercurial salt is thrown almost directly into the blood, giving an immediate and most vigorous therapeutic effect, but one which, if that action is to be sustained, requires repetition of the medication every day. When an insoluble preparation is injected the therapeutic action is a little less prompt and vigorous; but a depot of the drug is established, from which a constant supply of medication is supplied to the body for a time that is variable, but certainly lasts a week or two. The indications for, and the methods of employing, these two kinds of injection treatment are so different that they will be considered separately.

Regarding the mercurial injection treatment in general, we owe the soluble salt method to Hebra and Kaposi, and the insoluble one to Sca-renzio, both being first proposed and employed about the middle of the

last century. For a long time they were but little used, in spite of the admitted fact that introducing the drug into the system by placing it under the skin or in the muscles or in the veins was undoubtedly the quickest, most effective, and most exact method of employing it. Habit and prejudice threw their influence in favor of the older and easier, if less effective methods. The authority of the Vienna school, which long dominated syphilography, was thrown in favor of inunctions, while a large part of the profession clung to the still older ingestion methods. Some fifteen years ago, however, the movement in favor of the injection treatment received a new impetus; and to-day it is the method employed by advanced practitioners the world over.

Its advantages over other methods are manifold. It is the most effective treatment of all, giving results more quickly than any other. In a space of time so short that it is measurable by a few hours, or an hour or two, the entire system is impregnated with the drug, and its good effects begin to manifest themselves. Objective symptoms, as skin eruptions and ulcerative lesions, begin to improve in a day or two. It is the subjective symptoms, however, that show the therapeutic effect of the injections most brilliantly. Improvement in general feeling begins in a few hours. I have often had occasion, when treating a physician suffering from that very common and most distressing symptom of early lues, the obstinate cephalalgia, to ask the patient to note with exactitude the time required for him to notice improvement in his condition. Very frequently the headache, which may have been present for days or weeks, begins to improve in less than half an hour, and is entirely gone in two or three. Symptoms disappear and lesions heal with a rapidity that is startling. It is renewed occasion for marvel, accustomed as we are to this, each time we see it; though it has apparently been forgotten by those who have lately been recording similar phenomena from the arsenobenzol medication.

Of the advantages of the method in regard to the complete protection from irritation of the gastrointestinal canal, and the possibility of exact dosage, I need say but little. I have found that, as a rule, the patients themselves prefer this method to any other. They are relieved of the necessity of remembering to take medicine several times a day for long periods of time, even when they are feeling perfectly well. They need not carry around medicines or pills, and they would much rather visit the physician at stated intervals to receive their treatment than to take medicine surreptitiously several times a day. For it must never be forgotten that, much as we may be compelled to deprecate it, the fact of the patient's infection and treatment must usually be kept a profound secret from his relatives and friends.

Important as are the advantages of most vigorous treatment, efficiency, ease, and secrecy to the patient, the method commends itself in no less degree to the attendant physician. Medication is entirely in his

hands; he regulates the dosage and the frequency of administration. The efficient flexibility of treatment given in this way cannot be overestimated. Symptoms may be forestalled or efficiently treated at their very beginning; and the medication may be accurately regulated in accordance with the needs of the case.

Many objections have been urged against the mercurial injection treatment of syphilis, mostly by those who have not used it systematically, or who are wedded to the older modes of exhibition. Some few of them are valid; and I here reiterate my assertion that, while the injection treatment is that of election in the vast majority of cases, it is not suitable for all of them. It cannot be used in infants and young children, both on account of the delicacy and vulnerability of their tissues, and because of the fright and resistance necessarily present. A few hypersensitive patients would rather go to any amount of trouble than stand the needle pricks; and in a few others the tissues are not suitable for certain forms of injection. Serious accidents from the injections, the pictures of which have been drawn so vividly by my friend, the late R. W. Taylor, do not occur when the correct technique is employed and the proper precautions are observed. Once in tens of thousands of cases an instance of idiosyncrasy to mercury is met with, and accidents may occur; but the same is true for mercury administered in any other way; death has occurred from mercurial inunctions.

The two chief methods of mercurial administration by injection have each their advantages and disadvantages, and their enthusiastic advocates. The experience of many years has only confirmed me in the opinion that for the general, routine treatment of syphilis the insoluble salts have many and weighty advantages. There is undoubtedly, however, a field, though a restricted one, for the soluble salts medication; and, as is the case with the buccal and endermic methods, the wise practitioner is he who knows and uses all of them as occasion requires, though he may have his preferences for one or another. I distinctly prefer and recommend the insoluble salts; and most of what I shall have to say hereafter as regards the mercurial medication of syphilis will refer to them.

Soluble Injections.—This is admittedly the most active and vigorous form under which mercury can be therapeutically administered, and may be chosen in cases of emergency, when an important organ is threatened, or when, for other reasons, it becomes advisable to subject the patient's organism at once to the most powerful mercurial action obtainable. Injection of a soluble mercurial salt secures the almost immediate action of the remedy. The method has been quite extensively used for the systematic treatment of syphilis; but it is inferior for this purpose to the insoluble preparations, and for the following reasons: Mercurial elimination begins almost at once, and is very rapid, so that, in a day or two at most, all of it has left the body. Hence the injections have to be given

every day or every other day for long periods of time, and this involves a strain on the patient's patience and on his pocketbook that most individuals cannot stand. Then there is necessarily a good deal of pain; the soluble mercurials are all irritant, and some of them are active destructive agents. Patients soon object to this treatment; and I have only found it possible to employ it in emergencies and for short periods of time.

Any one of the soluble mercurial salts can be employed: the bichlorid, biniodid, benzoate, cyanid, cacodylate, peptonate, lactate, etc. An all-glass syringe must be used, and preferably an iridoplatinum needle, for the soluble mercurials have a most actively destructive effect on the ordinary metals. I emphasize this point since there is much confusion in the medical mind about it. The insoluble preparations are, of course, administered in suspension, and do not affect metals at all. They may be left in contact with them for any length of time without injuring them. The favorite location for these injections is the gluteal muscles; but any other large muscle mass may be selected. Injections under the skin have been largely abandoned to-day. They are more painful even than the intramuscular ones, and leave persistent tender inflammatory nodes. In spite of the fact that the solution injected is an active antiseptic, all the usual precautions employed in giving injections of any kind must not be omitted. We shall consider the following salts:

a. *The Bichlorid*.—This extremely active salt is unfortunately very painful, and very prone to cause stomatitis and diarrhea. Various formulæ have been recommended; as good as any is a plain aqueous solution with the addition of a little glycerin, made up so that 10 drops, the usual injection amount, contains the average dose, 1-24th of a grain. A standard formula is the following:

℞ Hydrarg. chlor. corr., gr. 1 (0.065 gm.).
Glycerini, dram 1 (4.0 gm.).
Aquæ destillatæ, drams 3 (12.3 gm.). Dose, 5-10 drops.

b. *The Biniodid*.—Nicolas recommends this preparation in a 4 per 1,000 sterile oil solution; ten drops of this equals about 1-24th of a grain. This has no advantage over an aqueous solution, which is much more easily prepared. The formula proposed by Levy-Bing is the following, the iodid of sodium being added to promote the solubility of the mercurial:

℞ Hydrarg. biniodidi, gr. 1 (0.065 gm.).
Sodii iodidi, C. P. and dry, gr. 1 (0.065 gm.).
Aquæ destillatæ, drams 4 (16.0 gm.). Dose, 5-10 drops.

The dosage is the same as that of the bichlorid formula above given. The salt is efficient and a little less painful than the bichlorid, but is about equally prone to cause trouble.

c. *The Benzoate*.—This is one of the least irritant of the soluble mercurials, and has been especially advocated by Gaucher. Unfortunately the commercial benzoate of mercury is frequently impure, and the procedure recommended for its purification is entirely too complicated for general use. It is most commonly employed according to the following formula, which, however, is admittedly open to the criticism that it is impossible to tell how much of the drug reaches the tissues in the form of a chlorid and how much remains a benzoate:

℞ Hydrarg. benzoatis, gr. 1 (0.065 gm.).
Sodii chloridi, gr. 1 (0.065 gm.).
Aquæ destill., drams 4 (16.0 gm.). Dose, 5-10 drops.

The benzoate is a little less active than the previously discussed soluble mercurials, and must be given in a larger dose. It is my favorite among the soluble mercurials on the rare occasions when I feel obliged to use one.

d. *The Cyanid*.—This is perhaps the most irritant of all the soluble mercurials, and the formula for its use should contain cocain. Darricr and Abadie recommend the following:

℞ Hydrarg. cyanidi, gr. 1 (0.065 gm.).
Cocain hydrochloratis, gr. 1 (0.065 gm.).
Aquæ destill., drams 4 (16.0 gm.). Dose, 2-5 drops.

The salt is very toxic, and must be employed with caution.

e. *The lactate, peptonate, and cacodylate* may be administered in formulæ similar to those of the above; I have been unable to convince myself that they have any advantages over the simpler salts. The same may be said of the various soluble mercurials in organic combinations that have been put on the market under various proprietary names during recent years.

Insoluble Injections.—The treatment of constitutional syphilis by the intramuscular injection of an insoluble mercurial is the method which I employ in the great majority of cases; it is the one which I recommend for the regular treatment of the disease. A wide experience with the various preparations and methods has led me to the employment of a certain preparation and a definite technique. Most of this section, therefore, will be devoted to the description of the method which I recommend as the best that can be used; briefer mention being made of the other varieties of the medication.

At about the same time that soluble mercurial injections were first employed the insoluble salts were experimented with by Scarenzio and his immediate followers. Their therapeutic results were good, but the indiscriminate heroic dosage and the absence of antiseptic precautions led to

many accidents. Abscess formation, stomatitis, enteritis, mercurial poisoning, and even serious illness and death occurred. This necessarily discredited the method very greatly, and it fell into disrepute and disuse. But its advantages in effectiveness and convenience were so great that therapists still experimented with it. It was found that the dangers of infection were certainly no greater than with any other injection, and could be avoided by the customary antiseptic measures; and that the mercurial dangers were almost entirely due to want of care in dosage and methods of administration. Finally, in the hands of Lang, Lewin, and Barthélemy, the insoluble injection method was perfected and systematized; and to-day it is the therapeutic method of election of many of the leading syphilographers the world over, and is increasingly employed by the general practitioner also.

A few words as to the theoretical basis of the treatment will not be out of place. Constitutional syphilis is a chronic infection in which the organic cause of the disease reaches the remotest recesses of the system, and there develops its effects. Not the body fluids and the large central organs alone, but the remotest capillaries of the skin, etc., show it. Vascular and lymphatic occlusion is one of the invariable pathological findings; and behind this are intrenched the active elements of infection. Naturally, in a process of this nature, no sudden flooding of the system with a medicament, no matter how powerful, is likely to destroy all the elements of contagion; a steady and persistent action, extending over long periods of time, is required. This has been forgotten in the enthusiasm over the newer arsenical treatment; but it has always been recognized in the administration of mercury. The drug must be administered steadily and for long periods to develop its best effects. With a soluble salt poured almost directly into the body fluids, and as rapidly excreted, this entails a constant repetition of the injection at very short intervals; they must be given daily, as we have seen. The theory of the insoluble injections is different, and the practical results from their use have demonstrated that it is correct. The insoluble mercurial compound deposited in a vascular and actively absorbing living tissue is changed with greater or less rapidity into a soluble salt. A steady stream of the medicament, reaching its height only after several days, and continuing for from one to two weeks, is sent through the body; and all the good effects of repeated soluble injections are gotten from a single injection. The difference between giving daily injections and employing a treatment that necessitates an injection only every five, ten, or fifteen days is one that will be notably appreciated by the patient. The establishment of a mercurial depot in the body has, it is true, certain disadvantages. Experience has shown, however, that they are almost entirely theoretical; such as they are, they will be considered later when speaking of the difficulties and dangers of the insoluble injections.

The insoluble mercurials used in the injection treatment of syphilis are few; each has its good points and its advocates. We need consider only metallic mercury, calomel, and the salicylate of mercury. My favorite is the salicylate, for reasons that will be apparent later; and the technique that I shall describe in detail is that which I have developed in the course of years of its employment.

a. Gray Oil.—This is the name under which metallic mercury suspended in extremely minute subdivision in an oily menstruum is employed. Lang and his pupils have been the most energetic advocates of this treatment; and there can be no doubt at all that it is a most vigorous and efficient mercurial medication. Unfortunately, however, its value seems to depend very largely upon the menstruum that is employed, and the method and care that are used in its preparation. The exact specific gravity of the oil, and the time taken for the extinction of the mercury; in other words, the fineness of the subdivision of the metal, and the perfection of its suspension in the menstruum, are important elements in determining its efficacy. So marked is this that it is admitted by the advocates of the method that gray oils that are fresh, and in which the comminution of the metal has been pushed to the limit, are much more active therapeutically than older or less carefully prepared specimens. They are also, however, more toxic and more painful. This instability of gray oil is a serious objection to its use by the general practitioner; and I doubt very much whether the average druggist would take the time and trouble to supply a perfect specimen. Long's formula is as follows:

℞ Hydrarg. depur., drams 2 (8.0 gm.).
Axung. porc. recent.
Sebi ovil. recent, āā dram 1 (4.0 gm.).
Fiat extinct. perfectissima. Dose, 2 to 5 drops.

Two parts of this freshly prepared ointment are rubbed up with three parts of pure olive oil, making a gray oil containing 20 per cent. of mercury. The greatest care must be employed in all the steps of the operation; the finished product cannot be sterilized, since the use of heat would injure the emulsion. All the utensils employed must be carefully sterilized and washed with hot soda solution immediately before use. With all this care exercised, and, even when kept in a cool place, gray oil lasts only a few days; it must be freshly prepared at frequent intervals. It will readily be seen that, while this is easily done in a large clinic or hospital, where it is being steadily used, the preparation has serious disadvantages from the standpoint of private practice.

b. Calomel.—This was the mercury salt that I employed for some years until I was convinced of the practical superiority of the salicylate. It certainly stands only second to the latter, and is still the favorite with

many who employ insoluble injections. I have given it both in a watery suspension with glycerin or in oil. Its high specific gravity leads to certain practical inconveniences when the oily menstrua are selected; in a specimen unused for a length of time the drug cakes very solidly in the bottom of the bottle, and is with difficulty shaken up, and if the suspension is at all thick the needle is very liable to become clogged. My final formula was as follows:

℞ Calomelani vapor. prep., gr. 1 (0.065 gm.).
Glycerin. purificat., gtts. 5 (0.3 gm.).
Aquæ destillatæ, gtts. 5 (0.3 gm.). Single average dose.

Ten drops equal one grain of the drug, within which are the limitations of the dosage usually employed.

The calomel injections are somewhat painful, and various attempts to remedy this by the addition of guaiacol, orthoform, etc., to the formula have not been very successful. It is also a little more prone to occasion salivation than is the salicylate. As the preparation method of injection, etc., of this salt is precisely similar to that used for the salicylate, the reader is referred to the section below for these particulars.

c. Salicylate of Mercury.—This is the salt that I habitually employ. It is as efficacious as calomel in almost all cases; it is better borne and less liable to cause accidents; it is readily prepared and the suspension keeps indefinitely; and it is entirely suited to the need of general practice, where syphilis patients are not treated every day. Success in its employment, nevertheless, depends largely on a careful observance of the necessary technique both in preparation and in administration. I shall consider the injection fluid, its qualities and preparation, the instruments to be used in making the injections, the site to be selected, etc., the general arrangement of a mercurial course given in this manner, and the various difficulties and dangers, alleged and real, incidental to its use.

1. The Injection Fluid.—The mercurial salt to be used is the insoluble basic salicylate of mercury, containing 59.52 per cent. of metallic mercury; not the neutral salicylate, which is a soluble preparation; there has been some confusion from this cause. As menstruum I have long ago rejected all watery fluids with glycerin or gum additions; they decompose and are not nearly so satisfactory as the oily menstrua. This latter should not be one of the organic oils, which are variable in composition and unstable. A mineral petroleum oil is the best. This can be had of varying specific gravity, and I have experimented a good deal in the endeavor to find one of a weight sufficient to keep the salt well in suspension, and yet thin enough to flow freely through the needle. The product known as albolene in commerce is about as suitable as any that I have found; and this is what I habitually employ.

The preparation of the emulsion must be carefully made, for on this depends, to a large extent, the suitability of the product. This care, however, is nothing more than can be readily undertaken by physician or druggist; and since comparatively large amounts of the emulsion can be made at one time, and it keeps indefinitely, it is no obstacle to the method. Thorough and careful comminution of the salt makes a more perfect emulsion, one less liable to hard caking when

left standing for long periods, less liable also to clog the needle, and less painful to the patient. The powder should be put in a mortar and the oil added a few drops at a time and with plenty of rubbing. An hour or two may well be devoted to the rubbing up of the emulsion, since a quantity may be made that will last even a busy practitioner a long time. Many of the emulsions that have been sent to me with complaints have simply been specimens that have been imperfectly prepared, with a resultant coarsely granular and flaky sediment, caking readily into difficultly emulsifying masses, clogging the lumen of the needle, and bringing the entire method into disrepute.

It is a minor but important convenience to have the emulsion put up in the ordinary half-ounce phials of the pharmacist, and not in any sized bottle or salt mouth. These phials are just of the right size to be occluded by the ordinary hypodermic syringe or by the special injection syringe that I use, and which will be described later on. By simply inverting the bottle on the syringe after shaking any desired amount of the emulsion may be drawn out without loss. The syringe need not be plunged into the emulsion, and the necessary exposure to the air and to contamination is reduced to a minimum. A half-ounce bottle suffices for from 25 to 50 injections; so that whatever the care entailed by its preparation, and whatever the consequent cost, the treatment is an entirely inexpensive one.

The emulsion being prepared, it should be submitted to one thorough and careful sterilization. This is rather for the purpose of rendering the containers safe than of treating the emulsion itself. This latter consists of a mineral oil, absolutely stable and unchangeable, and the insoluble salicylate, which has the same properties. Sterilization is effected as follows:

The new bottles and corks to be employed are sterilized by boiling and permitted to drain and dry; each bottle is then entirely filled with the emulsion and temporarily stoppered with a pledget of cotton. The filled and stoppered bottles are then placed upright in a water bath full of cold water up to their necks; and the bath is gradually brought up to a slow boil and kept there for an hour. The bottles are then taken out of the bath, wiped dry, and the cotton pledgets replaced by the sterilized corks. These latter are then tied on and the heads of the bottles dipped into melted paraffin to seal them perfectly.

The salicylate emulsion in varying strengths is put up by various foreign pharmaceutical houses in sealed ampullæ, each one containing an average dose. This method of keeping the suspension is attractive but not practical. Not only is it very expensive; the emulsion does not seem to be fine enough, and the small amount of it in each ampulla renders it impossible to shake up properly. The result is a hard and irremovable deposit in the bottom of the little vessel and a practical failure of the injection.

Once filled and sealed, the emulsion bottles may be preserved indefinitely; they are ready for use at any time at a moment's notice. It is entirely unnecessary to attempt any further sterilization. I habitually keep several bottles of different strengths in use at one and the same time, and I use them up to the last drop. I have even left bottles of the emulsion, partly used, uncorked for weeks; careful examination has then shown a layer of dust and microorganisms on the surface of the fluid, but an absolutely sterile emulsion. And not only is the preparation absolutely stable and unchangeable in contact with the air; it has no effect at all, save a preservative one on account of its oil, on metallic surfaces. My syringe has a solid metal plunger; and in the oldest one now in use in my office, which must have seen at least five years of service, the polish of the nickel plate on the end of the piston has not even been dimmed by constant contact with the emulsion. For, as will be seen below, I do not cleanse the emulsion out of

the syringe after using it. The plating of the sides of the cylindrical piston is worn off from constant friction at the cap washer, but otherwise the metal parts are as perfect as if they had been preserved in oil.

For many years I used a 10 per cent. suspension of the salicylate in albolene; lately I have been trying a 20 per cent., 25 per cent., and a 50 per cent. mixture. The idea was to reduce the size of the injection mass and so diminish the mechanical injury to the injected tissues. A 50 per cent. emulsion, being equal parts of the drug and the oil by weight, produces a thick, creamy fluid, which does not cake even when left standing for months, and is very readily shaken up. It is very satisfactory for those who employ the treatment largely; the usual dose, 2 to 5 drops, being so small as to cause a minimum traumatism; and any supposed danger of fat embolism is practically obviated. But it requires rather more skill in technique on account of the large proportion of solid matter in the fluid; and the needle and syringe require cleansing after the injection for the same reason. A 20 per cent. suspension is not open to these objections; and either one of these is suitable for general use. The ordinary dose is contained in from 5 to 10 drops.

2. The Injection Implement.—Any hypodermic syringe can be used, and any needle, provided the former has a barrel narrow enough to permit accurate drop dosage and the latter is long enough to reach the muscle mass and of sufficiently large caliber not to be too readily plugged by the thick emulsion. It is required also that the syringe-needle joint be of the slip or bayonet variety, since an important point of the injection technique consists in detaching the latter after the needle is in the tissues; this cannot be conveniently done with a threaded connection, nor without disturbing the needle in the tissues considerably. Besides this, an instrument that is used for ordinary hypodermic work with watery solutions must be thoroughly dried out before it can be employed for the oily emulsion and must be laboriously cleansed after its use.

Some years ago I devised a syringe for the special purpose of giving these injections which answers all these requirements and has a number of additional advantages. It is obtainable from the surgical instrument makers. Its barrel is made of accurately calibrated thermometer glass, graduated in drops, and so narrow in diameter, though the glass is fairly thick, that each drop measures three-sixteenths of an inch. Air bubbles, etc., can be seen and expelled, and an accurate dosage given. The piston is a solid metal rod fitting the lumen of the tube accurately; there are no washers save the one inside the cap, which does not come in contact with the injection fluid at all; nothing but glass or metal does that. The head of the piston is made in the shape of a large, heavy, flat disc; this gives weight to the instrument, facilitating the necessary rapid insertion plunge, and also permits the filled syringe with needle attached to be stood upright out of reach of contamination while the injection site is being prepared. The needle end fitting is a slip joint, permitting instantaneous attachment and detachment; the end of the piston fits accurately into it and its distal extremity fits accurately into the needle cap; there is therefore no vacant space anywhere when the plunger is driven home. A small pair of arms on the head facilitates handling; and I have had some made with small longitudinal bars along the barrel to strengthen the instrument and prevent breakage. But the instrument is not fragile: I have used the two which I employ daily in my office for years.

The needles must be long enough to reach, through the skin and fat, deep into the mass of the muscle selected, and of fair caliber. The so-called antitoxin size is about right in ordinary cases. Their length should be at least $1\frac{1}{2}$ inches. A needle insufficiently long, or not plunged in deep enough, leads to deposition of the emulsion in the subcutaneous fatty tissue, with consequent increased pain,

poor absorption, and a tendency to the formation of persistent nodules. Women, who usually have a much greater development of fat over the buttocks, where the injections are almost invariably given, require a longer needle; and each syringe case contains, besides four needles of the above size and caliber, two that are 2 inches in length and of slightly larger lumen. I keep a needle for each patient under treatment; but this is not necessary if sterilization, as recommended below, is carried out.

Sterilization of the syringe itself is entirely unnecessary; I do not even have it done in my out-patient service, where large numbers are treated. Besides this, boiling destroys the calibration and loosens the cement that holds the glass piston to the metal head and tip. There is absolutely no air space in the closed syringe and nothing that can be contaminated. An extremely tenuous layer of the sterile and non-contaminable emulsion is all that can be inside it. Only the slip joint of the syringe comes in contact with the suspension and with the outside air or other objects, and this can be sterilized before drawing in the suspension by passing it once or twice through the flame of a spirit lamp.

Needle sterilization in the ordinary way by boiling is destructive, as well as time-wasting and troublesome. The needle after an injection is filled with the sterile and metal-preserving oily suspension; only its outside is exposed to contamination. This outside is a highly polished steel surface and passage of the needle and stylet two or three times through an alcohol or small Bunsen flame is entirely sufficient to destroy all infective material that may be on it, including that of syphilis. This flaming should be done quickly; though if it is prolonged sufficiently long to take the temper out of the needle no harm is done to its point or lumen. In fact I have several times thought it an advantage to have had a needle without temper in my hands when attempting to inject an especially tough skin; the needle bent, instead of breaking, under the impact. Since much of the painlessness of the injection depends on the rapidity of the needle insertion, the needle points should be kept in good condition and sharp.

3. The Injection Site.—The insoluble injections are always given deep in the muscular tissues; and there are only two places in the body where the muscle mass is large enough and the skin insensitive enough for the purpose. The large muscles between the shoulder blades may be employed, but patients complain that there is discomfort when lying in bed and when using their arms. Practically I now use only the gluteal site, selecting the area between the trochanteric fossa and the middle line. This gives a skin surface of a least 6 by 4 inches on each side, sufficient for six separated injections. By systematically using alternate sides and successive locations, six to eight distinct locations can be got; so that, even if the injections are given at fairly short intervals, it will be several weeks before it becomes necessary to employ the same site again. It is unwise to make the injection on the side of the buttock, as the main muscle mass is reached with less certainty; and it is decidedly inadvisable to do it over the trochanteric area, where there are dense masses of connective tissue. Placing the emulsion under this latter inevitably leads to needless pain and disability. The direction of the needle should be downward and outward, so as to reach the center of the gluteal mass.

The skin of the injection site can be sterilized by any of the means usually employed for that purpose. The plan that I use is rapid and has proved perfectly satisfactory. The area is scrubbed with a piece of gauze and an antiseptic lysol or phenol solution; and then the process is repeated with plenty of ordinary ether. By this means all the superficial detritus and fat is removed; and the evaporation of the ether produces a certain amount of cold anesthesia that perceptibly diminishes the pain of the puncture.

4. The Injection.—The best position in which to administer the injection is with the patient standing upright, with heels together; it is an advantage also that the patient cannot see what the operator is doing or interfere with his work. Some operators make patient lie down, but I have not found this either necessary or useful. An important point is rapidity in manipulation; it greatly diminishes the patient's anxiety and causes much less pain if the work is done quickly.

The operation is begun by sterilizing the needle and stylet in the alcohol flame; for, as will be seen later, it may become necessary to use the latter in the course of the injection, especially if high percentage emulsions are employed. The needle is then placed on end in a safe place; the bayonet joint of the syringe is then passed through the flame and the syringe placed on its head. The emulsion is thoroughly shaken up, the syringe is filled with a little more of it than will be used, the needle put in place, and the prepared instrument placed upright again to permit any air bubbles to rise to the top. Meantime the injection site is prepared as above described and covered with a pledget of sterile gauze. The air bubbles are then expelled from the syringe, the covering cotton pledget removed from the injection site, and the prepared instrument rapidly plunged up to the hilt into the tissue at the site selected. If this is done quickly and without hesitation, into the skin cold with the ether, there is no pain about the manipulation at all.

The instrument once *in situ*, a certain precaution must be employed which I always insist upon, and which merits special emphasis. The chief danger of the injection, though I know that its importance is much overestimated, is that of fat embolism of the pulmonary vessels. If the point of the needle should be placed in the lumen of a vein the oily emulsion will be injected directly into the circulation. The occurrence can be avoided with certainty by the following procedure: Immediately after the needle is plunged into the tissues the syringe is detached and the interior of the needle cap watched for several seconds. The needle and cap is filled with the emulsion; and in the latter there is a concave white dome of the fluid, due to capillary attraction of its sides. The least flattening of this dome, the least inversion of this fluid cap, shows that the point of the needle is in a place where there is pressure from behind, and that can only be a vessel. The advice sometimes given, to regard extrusion of the injection through the unattached needle, or even a flow of blood, as the danger signal, is bad; the venous pressure is slight, and in a small vessel may not be sufficient to do either. If the site is not satisfactory the needle is to be withdrawn, resterilized, and a new injection site used. Piercing a blood vessel with the needle in its course through the tissues is of no matter; the minute vascular lesions do not permit any of the fluid to reach the veins after the instrument is withdrawn. Such an occurrence leads to some oozing of blood from the puncture site after the injection is completed, readily controlled by a little pressure with a pledget of gauze.

The needle being implanted in a safe site the syringe is reapplied; and it is this part of the manipulation that renders the employment of an instrument with a slip needle joint so advisable. A screw joint of the ordinary kind makes it very probable that displacement of the needle point may occur after the injection site has been judged safe. The injection itself is then made slowly and steadily. When it is completed the syringe and needle is withdrawn as quickly as it was inserted; and here also rapidity of execution will do much for the patient's comfort. Immediately on withdrawal the orifice in the skin is closed with a pledget of cotton, and then a small piece of zinc oxid adhesive plaster is applied. I do not massage the site of the injection, as has been recommended by some. It does

not do any special good; and, theoretically, it might force some of the emulsion into a vessel that has been wounded by the needle passage.

The immediate effects of the injection vary with the sensitiveness of the patient and also with the skill with which it has been done. In the great majority of patients the process is practically painless. A few hours after there is a bruised feeling. To use their common expression, they feel as if they had been kicked. This wears off in a few days. Hard persistent indurations rarely occur when the operation has been correctly done. Either the emulsion has not been prepared with sufficient care, so that the salicylate is deposited in comparatively large and irritant masses in the tissue; or, what is more commonly the case, the puncture direction has been wrong, or the needle has been too short; in either case leading to deposition of some or all of the emulsion in the subcutaneous fatty tissue, where vascularization is poor and absorption slow. Once formed these tender indurations may last a long time, but they do no other harm. They are slowly absorbed and finally disappear.

Another occurrence that may interfere with the success of the injection is plugging of the needle with the salicylate during its course. This is especially liable to happen, of course, with the stronger emulsions; and this is why I do not recommend the 50 per cent. strength for general use. It practically never happens with the 10 per cent. and is rare with the 20 per cent. When it does occur the needle must be detached and the sterilized stylet employed to push the occluding mass forward; it is hardly ever necessary to suspend the injection and reinsert the needle.

In some cases there is a distinct systemic reaction a few hours after the injection is given; it probably always occurs, but is usually so slight as to pass unnoticed. Sensations of chilliness, alternating with hot flushes, slight headache, and malaise, or a general feeling of discomfort may last for a number of hours. Once in a long time there is a distinct febrile reaction. Such effects may be expected from the injection of what is practically a metallic antitoxin into the system; but I have not found any case in which this effect was severe enough to interfere with the treatment. The great majority of patients do not complain of these after-effects at all.

5. Objections to the Mercury Salicylate Injections.—Criticisms of a mode of treatment that is a little unusual have at various times been made; some have a basis in fact, though mostly due to inexperience and faulty technique; most of them, however, are groundless. I propose to examine them in detail. It has been claimed that the injections are painful, that they leave behind persistent inflammatory nodules, that infections occur, and that there are dangers from embolism, general mercurial intoxication, and local gangrene and sloughing. There has never been any question of their remarkable therapeutic efficiency.

There is naturally some slight *pain* connected with any injection at the time when it is made; but, as has been explained when considering the details of the injection process, the amount of this is almost entirely dependent upon the care exercised in making it. The gluteal skin is as insensitive as any area of the body surface, and if this is partly anesthetized by cold, if the needle is sharp, and if the needle is inserted and withdrawn with celerity the pain is positively trivial or absent. Delicate women sustain it without any complaint. Of course there are individuals, even of the male sex, who faint when an acne pustule is expressed; and once in a long while I meet a patient, usually of that sex, who says he cannot stand the injections.

The discomfort that comes on several hours after the injection is a different matter. There is always some, though it varies greatly in degree. With most

patients it is a very bearable soreness of the gluteal muscles, especially when exposed to pressure. It is not great enough, however, to incapacitate him. Much depends on the size of the muscle and the amount of subcutaneous fat covering it; hence, women have less discomfort than men and fat less than thin individuals. Marked discomfort is more often due to improper implantation of the injection than to anything else; if it is placed under dense fascial tissues rather than in the center of the muscle mass the swelling that necessarily ensues gives some trouble. Discomfort is increased, of course, if the emulsion is put into the subcutaneous areolar tissue, where absorption is much slower. In the average case there is slight discomfort, only noticeable when sitting. It reaches its height by the second day and is usually gone by the fourth or fifth.

Some *injury* is necessarily done to the muscular tissue by the deposition of the insoluble material in its midst. Hence the instruction to make the injection itself very slowly, so as to separate the muscular fibers if possible, rather than to tear them. There is an *inflammatory reaction*, followed by a small connective tissue induration; but this disappears, and in a few weeks no mass can be felt. In malignant and recalcitrant cases, in which extensive series of many injections have been given, it has happened that I have struck one of these small indurated foci with the needle. The injection should not be given there on account of the dense unyielding character of the tissue. Another site should be selected.

There are infections, of course, which are due to imperfect asepsis only, and should be avoided. I have encountered them two or three times, but always under circumstances where a proper technique could not be carried out. The abscess, if at all large, should be opened and drained *secundem artem*. Small ones will be absorbed without trouble.

As explained under the heading of technique, *fat embolism of the lungs* does not occur when the proper precautions are observed, and when the injection is not made until the operator is sure that the point of his needle is not in a vein. The symptoms may be alarming; sudden pain in the side and on respiration, violent coughing, and blood-stained expectoration are alarming to the patient and often to the physician. But they invariably disappear in a few hours, for the amount of fatty material injected is so small that the tissues are quite able to take care of it. The essential innocuousness of the occurrence is well recognized, I am informed, in a certain genitourinary clinic in New York, where the injections are given without any precautions at all; embolism occurs quite frequently, but little attention is paid to it.

Practically all the cases of *gangrene and sloughing* date from the times when the method was little employed, the dosage too large, and the technique not aseptic. Those who dwell upon it to-day have gotten their facts from the old records rather than from experience. I have never met with a single case of the kind.

In considering *general intoxication*, no one can claim for a moment that the administration of mercury in any form and by any method is a perfectly indifferent procedure. The drug is a poison and idiosyncrasy to it occurs, though with extreme rarity. Hence it is wise, in a patient who has never had mercury and whose individual attitude to it is still unknown, to begin with an initial small dose, say half the usual amount, if the symptoms warrant a very little delay, and to proceed to a full dosage two or three days later. Reference may be made here to an objection, which is apparently cogent. It is claimed that, the dose of insoluble salt once injected, the physician loses all control of it. The mercury will continue to be absorbed as it becomes changed into a soluble compound. The same objection, however, holds good with other forms of administration, though to a less degree. Mercury may stay in the body long after its administration is stopped.

Experience and observation remove this objection. I have seen mercurial intoxication from the injections, just as I have seen it from the use of soluble injections, from inunctions, and from mouth administration of the drug. And it has certainly occurred no oftener, and I believe less often, than with these latter modes. It is relieved just as promptly by the usual measures; and I have never been obliged to have recourse to excision of a mercurial focus from the body or any such radical measure.

If I have devoted some space to these objections to the insoluble injection medication, it is because we find them repeated by one writer after another; though they are all unimportant and avoidable incidents in an otherwise most desirable and efficacious therapeutic method.

Iodin

Iodin and its salts are the second remedy for syphilis, and, in the minds of many practitioners, are of equal value to mercury in the treatment of that disease. Such, however, is by no means the case. The latter drug is a true specific, attacking the causative agent of the disease, in some, as yet unknown, way destroying or limiting its activities, and thus leading eventually to its cure. Iodin does nothing of this kind. So that it is quite inappropriate to treat a case with it alone, as is so frequently done. Yet the drug, used in lues since the middle of the last century, has certain valuable qualities that entitle it to its place. These are its undoubted and remarkable action on certain specific lesions after they have appeared, such as all the infiltrated, proliferating, or ulcerative lesions, especially those of the tertiary tubercular or gummatous type; and on the results of the syphilitic processes in the internal organs. Mercury is the drug to employ in practically every case of syphilis; iodine finds its field of usefulness most often in conjunction with it in the later stages.

Action of Iodin in Syphilis.—It is probable that the good effects of iodine and the iodic combinations in the syphilitic disease are due to the well-known property of this drug in stimulating lymphatic activity and increasing the energy of the nutritive processes. It thus promotes the absorption of disease products wherever they may be found. These products are much more abundant and stable in the later stages of the disease; but there occur cases in which similar phenomena occur in the secondary and even in the primary stages. In fact it may here be insisted on that the common division of the phenomena in a case of lues into those of the primary, secondary, and tertiary stages, useful as it may be clinically, is neither scientific nor absolute. Manifestations indubitably tertiary in type may occur with the chancre, and are often seen in or with the secondary manifestations; and here iodine is useful in the very earliest stages of the infection. Hypertrophic or phagedenic chancres, secondary hypertrophic or pustuloulcerative syphiloderms, malignant or precocious ulcerative forms of the disease may all be favorably influenced by its exhi-

bition. The point to be remembered is that it is the form of the syphilitic manifestation and not the time of its appearance which is the index for the employment of iodine; and that, whether iodine is indicated or not, mercury, in one form or another, always remains the weapon to use to combat the disease itself.

Now, of course, not all syphilitic phenomena occur on the exposed surfaces of the body and are immediately manifest to the eye. We have no criteria for the beginning of gummatous processes in the internal organs. In fact, their diagnosis is often a matter of doubt even when well advanced. Yet the earlier these ulcerations, proliferations, and infiltrations are subjected to the influence of the iodic medication the better are the chances of efficient therapeutic result. It has hence become customary, largely through the influence of Ricord and the French school, to administer iodine in certain stages of the disease, whether there are symptoms to justify it or not. It is believed by many that the drug has a distinct preventive action; that, by its employment, beginning infiltrative foci may be resolved. Inasmuch as it does not have the toxic action of mercury, and since its use in ordinary doses has no appreciable effect other than certain inconveniences on the system itself, I favor its employment in this way as a part of the regular treatment of the disease in addition to its use when directly indicated.

Absorption of Iodine.—All the mucosæ absorb solutions of iodine and of the iodic salts freely. The skin does so only to an inappreciable extent or not at all. Certain forms of the drug are suited for injection into the subcutaneous cellular tissue, as will be seen later. It is still a matter of doubt what occurs in the system after the drug is absorbed. Perhaps it undergoes a double decomposition with the sodium chlorid of the body fluids. Some hold that iodine itself is set free, to combine with the albuminous elements. It is established that most of the drug administered is excreted by the kidneys in the form of the iodid of sodium; and also that there is no tendency to accumulation of the drug in the system. It may therefore be employed with perfect freedom and in any bearable and indicated dose.

Elimination of Iodine.—Iodine passes very rapidly through the system; nine-tenths of the amount administered passing out in a few hours. Mauriac has shown that it can be demonstrated in the urine a few minutes after it is taken by mouth; and in less than half an hour when given by rectum or vagina, or by hypodermic injection. Though by far the greater part of it passes out through the kidneys, the other secretions and excretions do not escape. It can be demonstrated in the saliva, the nasal and bronchial mucus, the bile, and the milk. In 24 to 36 hours almost all of an administered dose has disappeared from the body; though by the use of extremely delicate tests Roux has demonstrated its presence for a number of days after massive and repeated doses of the drug. This extremely

rapid elimination of the drug probably explains its activity in effecting the resolution of cellular infiltrations.

Iodic Ill Effects.—Its rapid elimination and comparative nontoxicity render the frequent undesirable by-effects of iodine less important than those from mercury. Nevertheless, they are of such frequent occurrence that they must be noted. And in rare cases phenomena of greater seriousness occur. A disagreeable metallic taste, coryza of greater or less severity, and acne of the face and shoulders are phenomena so common as to be almost necessary effects of the treatment. They rarely call for any special measures or for stoppage of the treatment. The respiratory mucosæ may be more severely affected. Abundant nasal discharge, swelling of the nasal and ocular mucosæ, fever, headache, and general malaise may form a true iodic influenza. It ceases, however, very suddenly when the medication is stopped. Gastric derangement is common, and when slight in amount may be disregarded. When, however, there is anorexia, nausea, or vomiting, the effect on the patient's general condition may be so bad as to necessitate change in medication. Various cutaneous phenomena are liable to occur. The commonest is the acne above mentioned, which is only of importance from the viewpoint of the patient's vanity. Purpura, especially of the lower limbs, is also quite frequent. In rare case more serious eruptions occur, pustulocrustaceous, bullous, or vegetating iododermata. These are signs of excessive susceptibility to the drug, and are indications for the immediate stoppage of the medication.

Prophylaxis and Treatment of Iodism.—In spite of the long list of untoward by-effects of the medication, most of the happenings are trivial and do not interfere with the desired treatment. When the more serious ones occur the medication must be stopped. The symptoms soon disappear as the drug is rapidly excreted. The tendency, of course, is to look to lessening of the dose as the proper thing to do when iodic symptoms begin. Yet there is no doubt at all that the very reverse is often the proper procedure. It is a matter of almost daily experience at the City Hospital to find that patients who react badly to small doses of iodine can take large and massive doses without any trouble at all. Our usual dosage, of course, would be considered large in ordinary practice. We begin with 50 or 75 grains a day, and rapidly run up the quantity to any required amount. When a patient tells us that he cannot take the drug, or when ordinary doses begin to trouble him, it is a common experience to find all the symptoms improve and disappear when the amount given is rapidly run up to several hundred grains daily. I am quite unable to offer any explanation for this phenomenon; but it is a well-ascertained fact.

Many attempts have been made, by the addition of bicarbonate of soda, menthol, salol, potassium bromid, etc., to mitigate the unpleasant by-effects of the iodine, without, however, any appreciable benefit. Bella-

donna given simultaneously with the drug does diminish its irritant effects on the mucosæ; but its action is very short, it must be given continuously, and it is a drug not without deleterious effects of its own. As will be seen later the local gastrointestinal action of the iodine may be largely avoided by its administration hypodermically; but this mode of medication is troublesome and painful, and does not permit of the frequently required massive dosage. The many attempts to find an iodide that is free from undesirable by-effects has led to the recommendation of various albuminous compounds of the drug, peptoniodide, iodalbumin, iodothyron, saj-iodine, etc. These proprietary preparations are, in the first place, very expensive; a point of importance even in well-to-do patients in view of the large doses required. They are much less active than the inorganic salts; and, when given in doses therapeutically effective, they are just as liable to disagree as the others. One or two of them are of some value, however, and will find appropriate mention below.

Iodic symptoms, when they occur, must be treated on general principles. The iodic influenza, the catarrhal symptoms, the gastric derangements, skin eruptions, etc., must be handled like similar affections from other causes, with the addition, in the first place, of an attempt to check them by a large increase in the medication, and, in the second, a stoppage of the iodic medication, for the time being, at all events.

Iodine Preparations and Their Administration.—While there is not that choice in the administration of the iodine preparations which we have with mercury, there is more than one way of exhibiting it; and the patient is best treated whose physician employs any one of them, in accordance with the indications of the case.

ADMINISTRATION BY THE MOUTH.—This is the easiest and natural method of giving the medication; and is that of choice in the great majority of cases. As the preparations employed are mostly freely soluble, the common method is to give the drug alone dissolved in large quantities of water or milk. Absorption is rapid, especially when the dilution, as it should be, is great. Reference has already been made to the gastrointestinal irritation that not infrequently occurs; this is most marked when the drug is administered on an empty stomach; hence it should always be given after meals. One special precaution should never be omitted: Iodide solutions act on the proto-salts of mercury, changing them into the binary combinations. It is frequently necessary to give both drugs together, either as the so-called mixed treatment, to be considered later, or as separate doses. It is well understood that in any combined formula only the biniodide or the bichloride can be employed in appropriate dose; the protoiodide or calomel would be changed into one or other of these two, and would be poisonous in the same amounts. If it is desirable to give a proto-salt and an iodine preparation at one and the same time, care must be taken that a sufficient length of time elapses between the two doses

to permit the first to leave the stomach and upper intestinal tract before the other gets there. A common plan is to administer the mercurial an hour before meals, and the iodid an hour after eating. There is no chance then for decomposition and poisoning to occur.

The various attempts to prepare the iodids in pill form have not proven successful; they are very unstable and prone to deliquesce; and the dosage in which they must be given renders them unsuitable for this form of medication. Keratinized pills also are procurable, the idea being to prevent solution until the intestine is reached, and thus protect the stomach from irritation, but they are open to the same objections as the nonkeratinized preparations.

ADMINISTRATION PER RECTUM.—This method is not employed as much as it should be, perhaps on account of its disagreeable nature. Properly prepared iodid solutions are well absorbed by the rectal mucosa; and, when the administration of the drug must be long continued, when the dosage is very large, when the stomach gives out or for other reasons must be protected, or when the patient is unconscious, it may well be employed. The method is that of a rectal nutritive enema. The cavity is cleansed with a warm water or saline injection, and then from one to four ounces of a mixture of warm milk and warm saturated solution of the salt is slowly thrown into it and retained. Very effective medication can be accomplished in this way.

ADMINISTRATION BY SUBCUTANEOUS INJECTION.—Attempts have been made to use the soluble iodids in this manner; but the method cannot be recommended. It is very painful, and the amount of the drug that can be administered in this way is but small. Recently, however, there have been introduced certain oily iodid combinations, notably iodipyn, which have been quite extensively employed in this manner, and have given satisfactory results. Cases that have exhibited a most marked intolerance to iodine in other forms and by other methods of administration have borne them well. It is difficult to give them with the ordinary hypodermic syringe on account of the thickness of the oil in which the drug is dissolved. Barthélemy and Levy-Bing have devised a special instrument for the purpose, the essential feature of which is the propulsion of the medication by means of a piston that is screwed down instead of being pushed home in the ordinary manner.

Iodin Preparations and Their Dosage.—There are many of these that might be considered; I shall mention only those in common use or which have given good results in my hands.

Potassium Iodid.—This is the commonest and most generally employed of the iodine salts; it is the most powerful, and is the one to be preferred when a decided iodic medication is sought for. Its great solubility makes it possible to prescribe it in concentrated form; but it should be administered greatly diluted.

The common practice of exhibiting it in saturated solution is a bad one, since with one druggist that term means a true 100 per cent. solution, and with another one a fluid of considerably less strength. I usually write for a 50 per cent. solution, which is definite and unmistakable. The dosage is very variable; but I am in favor of large rather than small ones for reasons already given. The habit of giving ten or fifteen grains three times a day is a bad one. It will often fail to give the desired results. The initial dose, in cases where the drug is indicated, should be 50 or 60 grains per day; and the dosage should be steadily increased by the addition of one to five drops at each dose in accordance with the patient's tolerance or the therapeutic effect attained. There is no limit to the amount that can be given with benefit in certain cases. I have given as much as 1,400 grains a day before the disease symptoms receded under the drug; and in the City Hospital, where I treat syphilitics in large numbers, 150 to 400 grains daily is a common dosage.

Iodid of potassium is usually given by the mouth in large quantities of water or milk, and after meals. If the stomach proves intolerant, and the medication is urgently needed, rest in bed and the application of a fly blister or a mustard plaster to the epigastrium will enable the patient to stand it better. [It is not common usage to employ the large doses recommended in a routine way. The question of preventing iodism has not been solved. Administering the drug in increasing doses may be valuable. The administration of dilute solutions preceded by pepsin solutions is frequently serviceable. In not a few instances organic preparations may be given when no others are tolerated.—Editor.] It may be administered per rectum according to the following formula:

R Potassium iodidi, 50 per cent. solution, 2 drams (8.0 gm.).
Tinct. opii, 5 drops (0.3 c. c.).
Milk, 4 ounces (120.0 c. c.).

To be injected warm, and slowly, after a preliminary cleansing enema. In one case, brought comatose into the hospital with a history pointing to gumma of the brain, the patient did not begin to regain consciousness till a daily dose of 1,200 grains was reached; part of this was introduced into the stomach by means of a tube, and the rest was administered per rectum in divided doses.

Sodium Iodid.—The depressant action of the potassium base on the heart is supposedly avoided by the use of this salt. It is also somewhat better borne by the gastrointestinal tract. It is, however, less active therapeutically, and I have not found that it is less liable to cause undesirable by-effects. The dosage and methods of administration are precisely similar to those of the preceding salt.

Ammonium, Calcium, and Rubidium Iodids.—These salts have been employed in the attempt to avoid unpleasant by-effects. The first two are decidedly less active than the potassium and sodium combinations; and

the latter is so costly that its employment is prohibited in ordinary cases. I do not advise their use.

The Organic Iodids.—A number of these, under various proprietary names, are on the market, as iodalbacid, iodolose, iodothylin, sajiodin, etc. They are all open to the objections of being very expensive and containing comparatively small amounts of iodine. They are also just as prone to cause the undesirable by-effects as the inorganic compounds when administered in anything like equivalent doses. I have not found any of the claims of their manufacturers as to nontoxicity, etc., sustained. Nevertheless, they have certain advantages that render their use occasionally advisable. Being solid, they can be administered in capsule or as a powder, and can be carried around conveniently by travelers. They are also a resource to vary the tedious iodic medication with. I have found sajiodin perhaps the best of them all, though a very costly medication when administered in more than 20 to 30-grain doses. One organic iodid merits separate consideration, since it is the only preparation of the kind that is suitable for hypodermatic administration.

Iodipin.—This is a solution of the protochlorid of iodine in oil of sesame. Different strengths are obtainable, but the 25 per cent. solution is most suitable. A large amount, two to four drams, is injected at one dose under the skin between the shoulder blades; and a special syringe is required. This in itself is rather a severe procedure; and, in the case of a drug that is so rapidly excreted as is iodine, and therefore has to be given often, is certainly a mode of treatment that does not recommend itself to the patient. Besides this the indications for an intensive iodine treatment are never so urgent as they are for mercury. The cases that necessarily require iodipin injections must be very rare; I have never met one. It should be reserved, if used at all, for those in which neither mercury nor arsenic is effective, and in which there is a complete intolerance for iodine by any of the ordinary methods of administration.

The Mixed Treatment

Under this time-honored name a form of treatment, or rather a formula for the systematic medication of syphilis, has become so well known that it cannot be omitted here. Mercury and iodine are given together in fixed doses, and usually in one prescription. The common recipe is the following:

℞ Hydrarg. chlor. corr., seu biniodidi, gr. 1 (0.065 gm.).
Potasii, seu sodii iodidi, dram 1½ (2.0 gm.).
Syrup Zingiberis, dram 1 (4.0 gm.).
Aquæ, q. s. ad ounces 4 (120.0 gm.).
M. Sig. Dose, dram 1.

I do not use this formula, for the reason that it does not permit a ready gradation or change in the dosage of the two drugs. When it is desired to use them both together it is far better to give them in different doses or by different methods. The mercury can be administered by injection, or by inunction, or by the mouth in tablet or pill form. The iodine should be administered as described above, in solution by the mouth, or per rectum, or as one of the organic compounds. Even for patients who are travelers, or who can only be seen at long intervals, it is possible and much better to give each drug separately. If there are any active symptoms of disease to be combated the formula as above given is much less effective than the method I prefer. Its only advantages are those of simplicity and ease for both patient and physician.

Arsenic

In point of age arsenic ranks second among the recognized antisyphilitic drugs, and was used long before the iodine preparations were employed. The older textbooks dwell upon its merits, and no article on arsenic failed to mention its value as an antisyphilitic. It fell into disuse, however, and was forgotten, for the following reasons: Mercury was found to have such preëminent curative properties that a second remedy was unnecessary; and with the introduction of the iodine preparations in the last century it was felt that all the indications for successful treatment of the affection were fulfilled. Moreover, both these latter drugs were much less toxic and much less dangerous than arsenic, especially in the only forms of that drug that were then available, the inorganic combinations.

The revival of interest in syphilology which has marked the last decennium naturally stimulated therapeutic research in the attempt to discover still more powerful means to combat the infection; and, if possible, to remove it entirely. These researches have been mainly directed toward the organic compounds of arsenic, which were much less toxic in man than the inorganic ones, though equally inimical to some of the lower forms of life. The hope seemed not unjustified that a compound might be found powerful enough to completely destroy the spirochete in the body, and yet not toxic enough to affect human life. The marked effect of these compounds in tripanosomiasis and other similar affections led to the legitimate hope that like results might be gotten in syphilis.

The indefatigable labors of Ehrlich and his followers during the last ten years have placed at the disposal of the profession several antisyphilitic remedies of this new class. Most of them have already been abandoned; but two of them, atoxyl and arsenobenzol, require detailed consideration here. Atoxyl, on account of the repute that it still enjoys, and arsenobenzol as the new and marvelous antisyphilitic remedy that has

claimed the attention of the medical world so very largely for two years past.

Atoxyl.—Atoxyl is an anilarsenate of sodium and has been mainly advocated by Hallopeau and the authorities of the French school as a sovereign remedy for the syphilitic infection. Neisser's animal experiments seemed to show that a vigorous treatment with the drug begun early, a few days after infection, would absolutely abort the disease. On the other hand Zeissl, Scherber, Kreibich, and many others, while recognizing its powerful action, especially on tertiary lesions, regard it as a less active antiluetic than mercury. Unfortunately time has shown that it has some drawback and even real dangers. The conflicting reports concerning it show conclusively that it fails entirely in a certain proportion of cases; contrasting unfavorably with mercury in this respect; in which a complete failure of effect is among the very greatest of rarities. Where atoxyl is effective it is so in the same way as the older drug; that is to say, it relieves immediate symptoms and postpones or prevents new ones. Even in this respect, however, it is not so effective as mercury. New symptoms appear with even greater rapidity than under the older plan. The by-effects of the medication may be serious; gastrointestinal irritation, nephritis, and severe skin eruptions have been recorded in many cases. Most important of all, however, the drug, like all the arsenical compounds, may affect the optic nerve. Many cases of optic nerve atrophy and blindness have occurred from its use.

I entirely agree with Milian in his conclusions that the admittedly good results of the atoxyl medication in many cases are due to the arsenic itself, whose value as an antiluetic remedy has been forgotten; that equally good results can be obtained from an inorganic compound, as the sodium arseniate; and that the deleterious effects of the compound are to be ascribed to the poisonous anilin which it contains. I do not recommend the employment of atoxyl in syphilis. It finds a place here merely because it is still the favorite antiluetic remedy with a large and influential group of syphilographers, and as an incentive to conservatism in the adoption of new remedies in the place of old and tried ones. For atoxyl, like the other arsenical compound to be discussed below, was introduced as the ideal and radical cure for the disease.

When atoxyl is employed it may be administered in a 10 per cent. sterile watery solution; ten to fifteen drops being given hypodermically every day or every other day in courses and for periods depending on the symptoms of the patient.

Arsenobenzol, "606," Salvarsan.—No remedial preparation within our memory has been introduced under the peculiar circumstances that accompanied this, the latest and most famous of the organic arsenical antiluetics, and the only one of the group that bids fair to retain a permanent place in the syphilologist's armamentarium. The astonishing dis-

coveries in other branches of syphilis research have prepared the medical mind for wonders. The most extravagant claims were made for it; and it was received by the world at large with an enthusiasm to which the only analogue that I remember was that which greeted tuberculin years ago. Syphilis was conquered and would be banished from mankind, as tuberculosis was to have been in former times.

These considerations, however, are not reflections on the discoverer of the remedy or the many painstaking investigators who have experimented with it; nor do they absolve us from the duty of an earnest attempt to ascertain the exact status of the new remedy. That this can only be partially done at the present time is very evident. The drug has been in common medical use here for less than a year; and a much longer time is required before all the facts referable to it can be ascertained. Certain things, however, are already established concerning it. During the last winter we experimented extensively with the drug at the City Hospital, where the opportunities for syphilis investigation are unrivaled on this continent. We endeavored to observe results and record them with an open mind; and it is gratifying to note that the conclusions then reached have been confirmed by the majority of subsequent investigators.

It was evident very early in our investigations, in the first place, that arsenobenzol does not cure syphilis, in any real sense of the word, any more than mercury does. New symptoms, often wrongly called relapses, but which were only ascertainable evidences of persisting infection, occurred with at least the rapidity and frequency that we were in the habit of seeing under the older medication. And when I use this term it must be well understood that I mean thereby mercurial injections of soluble or insoluble salts, not the perfunctory and inefficient exhibition of protiodid tablets or mixed treatment. Nothing like a cutting short or abortion of the disease was noted in any case that remained under observation for a reasonable length of time; so that it was soon evident that a "therapia sterilisans magna," or complete destruction of all the invading microorganisms at one time, could not be effected. This is now generally admitted.

Arsenobenzol is thus placed in a position precisely similar to mercury as regards the luetic disease, and must naturally be compared with that drug. Is it more or less thorough and effective? Does it cut short disease manifestations quickly and permanently? Does it shorten the required period of treatment? Does it prevent the lamentable tertiary and hereditary sequelæ? And, if it has any disadvantages and dangers, what are they?

Manifestly, some of these questions cannot be answered at the present day. It will be at least five or ten years before a final opinion can be given. But some of the most important ones can be answered now.

There can be no doubt at all that arsenobenzol does influence many, perhaps most, of the manifestations of syphilis in a very rapid manner. The disappearance of symptoms, especially certain ones to be mentioned later, is sometimes as rapid as we ever see under the most thorough and successful mercurial medication. Sometimes it is slower than this latter; and occasionally the arsenobenzol does not influence the diseased manifestations at all. Like mercury and iodine, arsenobenzol fails in occasional cases; and some cases not influenced by the one drug will be amenable to the other. It is my conviction that symptoms reappear more rapidly after arsenobenzol than after mercury; which is quite an understandable occurrence. Once it is admitted that the new drug does not cure syphilis with one injection, or two, or three, the effect of such medication with a rapidly excreted drug cannot be as durable as that of antiluetic continuously poured into the blood for long periods of time. Of marvelous effects, of therapeutic action unknown formerly, I have seen nothing. These are the results of experience in a long series of carefully observed hospital and private cases.

The disease manifestations on which the drug exerts its most remarkable power are the early ones, and especially those appearing on the mucosæ. The initial lesion, exulcerated or not, the early roseola, and the later secondary rashes, the angina and mucous patches, the condylomata, and all the manifold symptoms of early lues sometimes respond to the drug most rapidly, as they do to mercury. I have seen mucosal affections cleared up by it which have resisted the older drug, as I have seen the reverse occur. On the later dermal, mucosal, and internal organ affections its action is often marked, though not more so than that of iodine and mercury. On the very late tertiary and the parasymphilitic phenomena its action is less pronounced. And on the latest lesions, the organic changes in the nervous system, and the internal organs it acts exactly like mercury and iodine; it does good in absolutely recent cases, and is inefficacious in older ones.

CONTRAINDICATIONS AND POSSIBLE DANGERS.—It would be strange indeed if the introduction into the system of a large amount of so active a drug as arsenic should not be attended with danger in certain cases; and it is unfortunate that so little note has been taken of the contraindications to the use of arsenobenzol. Accidents and undesirable by-effects occur with any form of effective medication. It is a question of their seriousness and frequency that determines the availability of a drug.

Arsenical Poisoning.—This has occurred in a certain number of cases, how many or in what proportion to the total number of administrations I am unable to say. I know of one case in which death occurred a day or two after an injection, and the autopsy showed the typical lesions of acute arsenical poisoning. I have heard of other cases, but do not know the facts. There is already a record of a number of deaths after injec-

tions, though most of them are explained away variously by the enthusiastic advocates of the drug. Of course, we are not likely to know a patient's individual reaction to a large dose of a powerful drug before we administer it, and idiosyncrasy is a factor with which we have to reckon in all medication. And, equally, of course, the question is one of proportion; though the case would be much stronger for the general employment of the drug if, as was at first proclaimed, syphilis could be radically cured with it.

Serious Derangements of the Circulatory System.—These are now universally acknowledged to be contraindications to the use of arsenobenzol.

Renal Derangements.—Though this has been hardly mentioned by the multitude of writers who have tried the drug, a considerable proportion of my patients showed marked signs of renal irritation. I do not advise the administration of the drug in any patient in whom the kidneys are not in perfect condition.

Advanced Disease of the Central Nervous System.—Here also all authorities agree that arsenobenzol is useless.

Optic Neuritis.—This, it will be remembered, was one of the chief causes that led to the disuse of atoxyl; and it has occurred from arsenobenzol. It happened in one of my cases, fortunately only in mild degree.

Skin Eruptions.—I have seen at least one case in consultation in which the injection of the drug was followed by a most obstinate general erythematous and pustular exanthem.

I am convinced that this is an imperfect list, since the time is too short, and candor has not been marked enough, for us to have, as yet, any complete and extensive records of results. But enough has been said to show that the injection of arsenobenzol is not indifferent medication, to be used generally and in all cases. So far as we can see now, it may be used in certain cases and with certain definite precautions in the treatment of syphilis. Just what cases these are we shall see when considering the general scheme of the constitutional treatment.

MODES OF EMPLOYMENT.—At the present time the favorite mode of administration of the drug is by intravenous injection; and it is certainly the least painful and the quickest. It is, however, open to certain serious objections. The arsenic is thrown at once into the circulation. It is entirely eliminated in three or four days; and the strain on the emunctories and the shock to the system are necessarily great. It would be a rational method if we expected to destroy all the invading microorganisms at once; but, as we have seen, there is no evidence that this can be accomplished. It is not the rational method if long continued and persistent action is desired. And this is recognized by many of its most enthusiastic advocates, who recommend that the intravenous injection be fol-

lowed by one or more intramuscular ones, or even by effective mercurial courses.

The intramuscular injection is the mode that I have commonly employed; it involves more discomfort to the patient, but is nearly as quick as the intravenous, and, I believe, is safer. It is entirely possible that finally we may come to use the drug in much smaller and repeated doses in courses hypodermatically, exactly as we do mercury. Into the details of the preparation and administration of the drug by either of the methods mentioned above I shall not here enter. They are quite complicated and lengthy, and they vary a good deal in the hands of various users. Besides this, they accompany every ampulla of the proprietary powder.

To sum up, in so far as this can be done at the present writing: Arsenobenzol, while it does not cure syphilis, is of undoubted efficacy in various forms of the disease, especially in early cases, in lesions of the mucous membranes, in especially severe or malignant cases, and in other instances in which, for various reasons, there is occasion for unusual anti-luetic measures. It must be used with care, since serious and even fatal accidents have occurred with it, and it must not be employed where there are serious vascular or renal lesions or advanced diseases of the central nervous system. Its immediate effects may be better than that of mercury, or slower and less certain. In some cases it fails entirely.

GENERAL PLAN OF THE CONSTITUTIONAL TREATMENT

The ideal method of treating syphilis, especially in its earliest stages, would, of course, be to administer a sufficient amount of the specific medicament to destroy all the spirochetes at once. It was hoped and indeed proclaimed that this could be done with arsenobenzol; but the evidence now before us shows that this is not the case; abortion of syphilis is just as impossible with this drug as with mercury. One measure is to be recommended at the very beginning of an infection when circumstances permit it, and that is excision of the chancre. For the details of this procedure the reader is referred to the section preceding on chancre excision.

Next in order is an attempt to cut short or limit the infection by a full dose of arsenobenzol, the pros and cons of which have been discussed above. It is hazardous in a work such as this to express an opinion regarding the use of a medication so new; but it is my practice to advise and administer an injection of the drug when there are no contraindications and circumstances warrant it. I regard it as an attempt to destroy as much of the infective material at once as possible. One full dose should be given either by the intravenous or the intramuscular route.

Whether arsenobenzol is given or not, full and thorough mercurial medication must at once be begun. Precise regulations for this course

cannot be given, since both the amount and method of the medication and the length of time for which it is to be continued will vary with every case. But a general plan can be laid down which will serve as a basis for the treatment of the individual cases. Three chief plans of mercurial medication are in use, which are best designated as the intermittent, the continuous, and the intermittent continuous methods of treatment.

The intermittent plan of treatment is used in Germany; it has not found much favor elsewhere. Medicine is given when symptoms appear and stopped when they are absent; and every disappearance of symptoms is looked upon as a "cure," and each coming again as a "relapse." This opportunist plan of treatment has the advantage of requiring a minimum amount of mercury and iodine; so that, when the use of these drugs is required, the system is in the best condition to be influenced by them. But there can be no doubt at all that the virus is present all the time, even during the months or years when there are no disease signs at all; and even, as experience is daily teaching us now, after the serum reaction has been repeatedly negative. Furthermore, we are never in a position to make any just estimate of the preventive action of the antiluetic medication, i. e., of its prophylactic effect. All lesions begin as microscopic foci, and even those that are on the surfaces, and so exposed to investigation, are often too small to be diagnosed for a time. This is much more the case, of course, with lesions of the internal organs, of the bones, of the central vessels, and of the nervous system. The great trouble is that we only recognize them when they have caused extensive change and destruction. In many cases we can only diagnose their after-effects. Who can tell how many such lesions are aborted or counteracted in their earliest stages by the intelligent and persistent treatment of a patient suffering from constitutional syphilis?

There are, however, distinct objections to a luetic treatment that is absolutely continuous for long periods of time. The remedies are poisonous, and cannot help but have a deleterious effect on the tissues and organs that are subjected to their influence permanently. Not a few of the cases that we meet in the hospitals, and in private practice also, are suffering from too much, rather than too little, medication. They are suffering from chronic metallic poisoning, rather than from syphilis; and they require food and sunshine rather than drugs. Besides all this, we must never lose sight of the fact that tolerance of almost any drug is established after a time. The medication loses its effect; and we may find ourselves hampered with an ineffective weapon at the very time when we need it most. No fact is better established in syphilis therapeutics than the one that the drugs employed show their best effects in systems that have not become accustomed to their use.

These considerations have led to the development, chiefly by the French syphilographers, of the system of treatment which I consider far the

best, and which I employ and recommend. It combines, as far as possible, the best features of both the other plans. Its real recommendation, however, is the fact that it has clinically been proven best in the hands of multitudes of skilled practitioners all over the world. With this scheme of treatment it is possible to make a definite plan; it being well understood, however, that it is tentative and schematic only; that few cases will fit into it exactly, and the great majority require its modification in accordance with individual requirements. It serves a useful purpose, however, in giving a general idea as to how a case of syphilis should be managed. It is called

The Continuous Intermittent Plan Treatment

Any mode of administration may be employed. I shall treat it as applied to the insoluble injection which I advocate. Treatment should be begun as soon as the diagnosis is made, as soon as spirochete findings, or a positive serum test, or any one of the earliest secondary symptoms show that a lesion that may or may not resemble a typical chancre is really an initial lesion. And treatment must be continued for three years. We may find in the future that, by the use of arsenic or some other remedy, it is possible to cut down this time. At present it is not safe to do so. And I make this statement irrespective of the results of the serum test. Valuable as it undoubtedly is, it may be repeatedly negative for a time after insufficient treatment, then to become positive again. I should never discharge a patient as cured on the strength of the serum test alone, unless I also knew that he had received efficient treatment for the length of time that experience has demonstrated to be necessary.

At the Beginning of the Infection.—Modern methods of microscopic diagnosis enable us to determine the nature of a suspicious tumor or ulceration far earlier than was formerly the case, and permit us to attempt the abortive treatment of the disease with better chances than were formerly possible. The chancre should, therefore, be excised when practicable. But since, so far as available statistics show, this measure does not, in the immense majority of cases, abort the disease, other treatment should be begun at once in any case. A vigorous antiluetic treatment should be instituted. I now give a full dose of arsenobenzol, either intravenously or intramuscularly, in cases where no contraindications are present.

During the First Year.—Here treatment should be most vigorous and prolonged, for the microorganic invasion is most active, and most liable to lay the seed for future mischief. Injection of the salicylate should be begun at once. Twenty to thirty should be given during this first course at intervals of from five to ten days. The amount of the drug administered, as well as the frequency of the injections, depends on the age,

weight, sex, and condition of the patient; as well as on the nature of any disease manifestations that may be present. Men take more than women, those of middle age more than adolescents and the aged, stout persons more than those of spare build; and, finally, the severer the type of the disease the more the medication should be pushed. An average dose would be 5 drops of the 20 per cent. emulsion containing 1 grain of the drug.

It is my invariable rule to give a less amount, say one-half grain, as the initial dose, to test the susceptibility of the patient; but I do not hesitate to give much larger amounts when circumstances, such as obstinacy of symptoms, demand it. I have given as much as 4 or even 5 grains at a dose, using of course the 50 per cent. emulsion for the purpose.

This first and most vigorous course will take about six months, and then an interval without treatment ensues, provided there are no symptoms. This interval lasts one to two months. If the symptoms are persistent, however, and reappear, the medication must be kept up no matter how many injections have to be given. It is sometimes advantageous to make a change in the form of treatment. Occasionally we find disease phenomena that resist one form, and yield readily to another. During the interval of nontreatment the patient should be kept under observation. He should be examined at least every two weeks, so that any symptoms that arise may be promptly met.

The second course is given during the last months of the first year; and, if the case is one that runs the ordinary course, it need be neither so prolonged or of such high dosage as the first one. Ten to fifteen injections of moderate strength will usually be enough. Here also we must be governed by the patient's general condition and the symptoms. Weak or debilitated individuals get less mercury, and those with relapsing or obstinate lesions more.

During the Second Year.—Here, under ordinary circumstances, the mercurial courses become shorter, the doses smaller, and the intervals between the medication longer. Two courses of ten to fifteen injections, of medium dosage, given at intervals of two weeks, will usually suffice. As during the first year, however, and perhaps more so, much depends on the patient's condition and symptoms. It may be necessary to be as vigorous and energetic in the mercurial medication as in the first year. It is during this year, also, that iodine usually finds employment. I invariably use it during this period. I am aware that there are those who hold that this latter drug should only be used when there are distinct indications present for its employment; that is to say, when there are definite cell accumulations or their results present as infiltrations, tumors, or ulcerations. But, just as was argued for the administration of mercury, even in the absence of palpable specific manifestations, it is impossible to diagnosticate the beginnings of these changes, and it is in their beginnings that they are most easily and satisfactorily treated.

I give the iodid, in whichever form selected, together with the mercury and for the same courses during the second year. The dosage varies according to circumstances; usually, and in the absence of definite symptoms, from 30 to 60 grains (2.00 gms. to 4.00 gms.) of potassic iodid or sajiodin suffices. But when occasion demands it I increase this amount very much.

During the Third Year.—Here, also, in the presence of good general health and the absence of special symptoms, the course may be moderate and arranged on the same plan as those of the second year. When symptoms do occur, however, large doses of the iodin preparations are in order. Mercury must not be omitted; but it is in this stage that heroic doses of iodin show their best effects.

In the above schematic plan of treatment it will be noted that the three years correspond roughly to the ordinarily conceived three stages of the disease: primary, secondary, and tertiary. Both divisions, however, are largely arbitrary, and are useful mainly for systematizing phenomena and therapeusis, and presenting them in orderly manner. Symptoms essentially tertiary in their nature may appear while the initial sclerosis is still present. In the same way the treatment laid down for the third year may become necessary within the first.

When a patient has gone through the three years of treatment outlined above he naturally asks his physician whether he is cured or not; and just as naturally his attendant tries to avoid answering the question. Especially should the latter be cautious when the question is asked with reference to marriage. No one can tell positively that a case of syphilis is cured, in the sense of the patient's never having any sign of the disease again, no matter what length of time has elapsed, or what treatment has been undergone. The Wassermann test helps us, but that is not infallible. Nevertheless, experience teaches us that the vast majority of patients who submit to a conscientious treatment as above outlined do recover. They remain free from disease symptoms, they marry, and do not infect their wives, and they have healthy families. It has been advised in some quarters, and I myself have done so, that it would be well for syphilitics, no matter how good their state of health, to have a short mercurial injection course once every year for as long a time as they have patience. This can be done with intelligent persons who can appreciate the conditions of our knowledge. I have some patients who come to me every year for a short mercurial and iodin course, which can do them no harm, and may prevent the advent of postsyphilitic or parasymphilitic phenomena. But the majority of patients need the encouragement of definite statements; and to such I was formerly in the habit of stating: Three years of efficient treatment, and one year without treatment and without symptoms, is the test; and the patient who goes through it successfully may regard himself as cured and may marry. In the light of our present knowledge I would modify it as follows:

A patient who has gone through a three years' course of treatment as outlined above, and, in the fourth year, without treatment, has no symptoms and shows a repeatedly negative serum test, is cured of his syphilis and has permission to marry.

LOCAL TREATMENT OF THE SYPHILITIC LESIONS

The local manifestations of syphilis are caused, of course, in the first place by the virus itself; but, in many instances, there is added thereto another infection, usually of the ordinary pus organisms. This secondary infection plays a much more prominent part than is usually supposed in determining the actual appearance and course of disease manifestations. All the ulcerative syphilodermata, from the exulcerated chancre to the open gumma, are examples of this dual infection; and so are most of the mucous membrane lesions, and not a few of those of the internal organs. In all such cases the general rules of surgical procedure apply; the greatest possible cleanliness, the free use of soap and water, the intelligent employment of antiseptics, the use of the knife for removing exuberant granulations and indurated edges, of the curette to freshen up indolent ulcerating surfaces, of the scissors to trim off condylomatous excrescences, etc. All these and many others will find a place in the local treatment scheme.

Besides their general action on the invading microorganism and its products through the blood, it is a matter of common observation that both mercury and iodine applied locally exert a powerful beneficial action on syphilitic lesions; and even arsenobenzol is now recommended by some as a local application in a 50 per cent. vaselin ointment, though with what success I am unable to say. No more striking example of the local efficacy of mercury in syphilitic lesions of the skin can be cited than that of a case recently reported and figured by Dohi, in the person of a Japanese whose integument was ornamented with the very elaborate and florid tattooing that is in vogue among certain classes of that people. The patient, among other designs, had a very large figure of a god encircling his body, the rest of his skin being covered with flowers, stars, and various emblems. The black parts of the figures were done in India ink, which is pure carbon; but the face and trunk of the deity, and many of the flower and symbolic designs, were done in red with cinnabar, a mercurial salt. This person contracted syphilis, and soon showed an abundant secondary papular eruption. Though the tattooing had been done a long time previously, the distribution of the eruption was most peculiar. It was very abundant on the untattooed portions of the integument, and was just as marked on all the blue-black tattooed areas, as the hair, eyebrows, eyes, and cloak of the god, and on all the other India ink devices. But on the face and trunk of the figure, and on all the red flowers and

emblems, not a single papule was to be seen. Microscopic and chemical examinations of the red areas showed a deposit of metallic mercury in the skin, evidently quite sufficient in amount to prevent the appearance of the syphilitic efflorescences in these especial areas. Mercury and iodine, then, in conjunction with the other local treatment indicated, form a not unimportant part of the measures to be employed in combating the syphilitic virus.

Local Treatment of the Chancre.—When an excision, which has been already considered, is rejected, the nature of the local treatment to be employed depends on the condition, size, and form of the initial lesion and the complications that may be present.

THE UNCOMPLICATED CHANCRE.—Here the lesion is a simple tumor, unulcerated and painless. The less we interfere with it locally the better. But it is certainly an unpleasant lesion for the patient to carry about; and sometimes no amount of explanation on our part will prevent the patient demanding that something be done. The utmost genital cleanliness must, of course, be observed; and whatever local remedies we employ we must be careful to avoid anything that will irritate or inflame the lesion, and still more any measures that will injure the epidermis covering it, i. e., convert a closed into an open lesion, and necessarily expose the patient to the danger of a local mixed infection. The use of a powder of pure calomel, or of a 25 per cent. or 50 per cent. calomel-starch mixture, is all that I allow when the lesion is on the mucosa. When it is on the skin, as on the outer fold of the prepuce or on the general integument, the cautious daily inunction of the officinal white precipitate ointment, or of a mild (10 per cent.) mercurial ointment, or painting with a 10 to 20 per cent. oily solution of the oleate of mercury, may be permitted; or the lesion may be covered with a piece of mercurial plaster. But any measures that irritate the dermal tissues, or even macerate them and render them more vulnerable, must be carefully avoided.

THE INFLAMED CHANCRE.—Here the tendency to breaking down must be combated by all the means at our disposal. Avoidance of all irritation, especially that of sexual excitement, rest, and wet compresses of boric acid, or of Burow's solution 1 to 10 of water, or hydrogen peroxid 1 to 5, are the best means to employ.

THE EXULCERATED CHANCRE.—Most of the initial lesions, when we first see them, are in this condition, the result often of neglect on the patient's part, or of efforts by himself or his attendant to "burn out" a suspicious lesion. Lunar caustic is responsible for this in many cases; and the occasion is a fitting one to animadvert on the indiscriminate use of this agent, especially in genital lesions. It is, of course, not a caustic at all in any true sense of the word. It is an astringent and irritant agent that has but little bactericidal power, but great influence in converting a closing lesion into an open ulceration, of permitting the en-

trance of adventitious germs, and of causing an inflammatory induration that may mask and conceal the essential features of a lesion.

The ulceration must be treated on general principles, plus the specific local medication. Cleanliness and absence of irritation, a mild (1 to 5,000) bichlorid wet dressing, or the ammoniated mercury, or the 10 per cent. calomel, or oleate of mercury ointments will render good service. Calomel powder, either alone or mitigated with starch, is a favorite application; and in public practice nothing does better than wet compresses of the old-fashioned black wash.

THE GANGRENOUS AND PHAGEDENIC CHANCRE.—The destruction of tissue and consequent deformity in these cases of mixed infection are sometimes very great, and persistent attention and care are required to limit it. Rest in bed should be insisted on; and hot bichlorid (1 to 3,000) or boric acid wet dressings should be used; peroxid of hydrogen dressings, as strong as can be borne, are also of use. Immersion of the lesion in water as hot as can be borne, for prolonged periods several times daily, is an efficacious measure. In the intervals the ulceration may be dressed with a mild iodoform, xeroform, or aristol powder.

In the worst cases, where the gangrenous action is spreading rapidly in spite of the measures above mentioned, vigorous surgical intervention is required. With the help of a preliminary local cocain or eucain anesthesia, or even a general narcosis, the entire base and margins of the ulceration must be destroyed with the actual cautery, nitric acid, the acid nitrate of mercury, or formalin; a wet boric acid or peroxid dressing being used afterward. Care must be taken to insure a good result, that the cauterizing agent reaches the depths of every fold and pocket of the ulceration. Dry heat is a very excellent method of treating these lesions; but it must be done thoroughly, and anesthesia is necessary. Hot dry air may be employed by means of one of the instruments devised for that purpose; but it is generally more convenient to use the Paquelin cautery. A flat point attached to the instrument is heated to a cherry red, and is held for several seconds close to all parts of the lesion. Actual contact and cauterization should not occur.

THE CHANCRE WITH PHIMOSIS.—Balanoposthitis is almost always present, and must be treated. If the prepuce can be retracted, careful cleansing several times daily with a bland soap and warm water, with the use of a mild boric acid powder, will suffice; the chancre itself being treated as in the uncomplicated cases. When the glans cannot be uncovered it may be possible by means of injections of warm boric acid or potassium permanganate, or weak lysol solutions, to cope with the affection. But if, as is usually the case, and as can be determined by the tenderness of the lesion and of the preputial sac, mixed infection and ulceration have occurred, more vigorous measures must not be postponed, since extensive destruction may take place in the closed sac within a short

time. The lesion, the glans, and the entire preputial sac must be exposed for examination and medication. A free dorsal slit of the sac, with careful suture of the edges of the wound, may be attempted, with a view of completion of the operation by circumcision later on. It is usually better, however, to do the circumcision at once. In either case, infection of the line of incision generally occurs, in spite of all our efforts to prevent it. Primary union may be obtained, but the scar subsequently hardens, and becomes a true linear chancre. Nevertheless, the ultimate cosmetic results are usually astonishingly good. Nature repairs apparently serious mutilation of the penis remarkably well. In any case, we have little choice in the matter. If the intrapreputial ulceration cannot be satisfactorily treated by irrigation in conjunction with internal treatment, extensive destruction involving the entire glans, the corpus spongiosum urethræ, and even the corpus cavernosum may occur; with all the dangers of serious hemorrhage, atresia of the urethra, false urethral openings, infiltration of urine, etc., added thereto.

THE CHANCRE WITH PARAPHIMOSIS.—The chancre must be treated in accordance with its character as here laid down. The paraphimosis must be reduced by manipulation, aided by hot water soakings of the organ and possibly the local use of cocain or adrenalin. If all other measures fail the constricting band must be divided with the knife, though infection of the cut surfaces will almost necessarily follow. The complication is an uncommon one.

THE URETHRAL CHANCRE.—Intraurethral initial lesions may give so little trouble as to be unnoticed or to be misinterpreted as attacks of gonococcal or ordinary pus infections. They usually require but little treatment; an abundance of water and the use of a bland alkaline diuretic to render the urine less irritating are often all that they require. The sclerosis and the coincident swelling of the urethral mucosa may, however, cause urination to be difficult or impossible; in which case the cautious employment of a soft rubber catheter, or of repeated suprapubic puncture to empty the bladder, or even a perineal urethrotomy, may become necessary. Urethral chancre, however, is rare; and still rarer are the instances in which the urethral stenosis is so complete that radical measures are necessary. It goes without saying, however, that in any case of intraurethral chancre the internal treatment should be of the most vigorous possible character, on account of the specially dangerous location of the sclerosis.

THE RECTAL CHANCRE.—This does not usually cause stenosis, the canal being very much larger and more distensible than the urethra. Cleanliness, hot irrigations, suppositories of calomel, iodoform, aristol, the mercurial ointments, etc., may be used with good results. The lesions, of course, always become infected; and while immediate interference with defecation is rare stricture of the rectum may be a late result. It

should be treated with dilatation by means of bougies or by operative interference.

CHANCRE OF THE VAGINA AND UTERINE NECK.—These are often undiscovered by the patient, and account for many of the cases of syphilis in women without a history of an initial lesion. Pain on intercourse and discharge may, however, call their attention to it. Antiseptic vaginal douches, especially of the bichlorid, vaginal tampons impregnated with calomel or xeroform, etc., or the ordinary black wash may be employed.

CHANCRE OF THE LIPS, MOUTH, AND TONGUE.—All irritants, such as tobacco, alcohol, and spicy or very hot or cold food or drink must be interdicted. For chancre of the lips, a calomel ointment, or the white precipitate ointment, or mercurial plaster, do well. Chancre of the buccal cavity or the tongue should be treated with frequent gargling with black wash, or a weak (1 to 10,000) sublimate solution.

CHANCRE OF THE GENERAL INTEGUMENT.—Under this designation I include scleroses seated on the sheath of the penis, the outer surface of the labia majora, as well as those in the usual extragenital locations, the fingers, nipples, and other points on the surface of the skin. Where location permits it, excision is certainly desirable in these cases. Unfortunately they are, of all scleroses, usually the latest to be diagnosed, on account of the unusual sites that they occupy. A 10 per cent. calomel ointment, 10 or 20 per cent. oleate of mercury in oil, any of the mercurial ointments or plasters, or a wet dressing of 1 to 1,000 of corrosive sublimate, is effective medication for these lesions.

Local Treatment of the Secondary Cutaneous Symptoms.—Our patients naturally dread the appearance of symptoms on the exposed parts of the body. Something can be done to prevent their occurrence, and a great deal to hasten their departure when present. It is well to order the employment of a mercurial soap for the hands and face once daily, or the inunction at night of a mild and innocuous mercurial, as the white precipitate ointment. I have observed good results from these measures, the skin of the face and hands remaining free, or nearly so, when the rest of the cutaneous surface was markedly affected. A face powder containing 5 per cent. of calomel may replace that in habitual use.

THE MACULAR AND PAPULAR GENERAL SYPHILODERM.—In their usually mild forms these eruptions hardly require any special treatment, save on the exposed portions of the body, whence they must be removed as quickly as possible. The white precipitate ointment used at night must be fortified with a certain amount of mercurial ointment; 5 to 10 per cent. will make it much more efficacious, and will not render it disagreeable in color or consistency. A fairly strong oleate of mercury ointment or oil, 20 or 25 per cent., may be painted over the affected surfaces several times a day.

THE PUSTULAR AND ULCERATIVE GENERAL SYPHILODERMS.—Here

the local pus infection as well as that of specific origin must be combated. Cleanliness is of the greatest importance; the affected areas must be washed with mild creolin or lysol or sublimate lotions as often as is required, and the dressings, if any are used on the worst areas, must be frequently renewed. Sublimate wet dressings, 1 to 1,000, may be used for lesions on the lower extremities or at the joint flexures, where they are usually worst. Mercurial ointment and white precipitate ointment in equal parts is a good general formula to employ.

Local Treatment of Secondary Syphilis of the Mucosæ and the Mucocutaneous Junctions.—These are so common as to form an almost invariable part of the symptomatology of early syphilis. They are disquieting and painful to the patient, and are a prime source of infection to others. The care of the mouths of syphilitics, and the measures to be taken to avoid spreading the contagion have been detailed under the heading of prophylaxis. The ordinary syphilitic angina is treated with a 2 per cent. chlorate of potash gargle, or 25 per cent. hydrogen peroxid, or a 1 to 500 permanganate of potash solutions. Genital and anal lesions must be treated on similar lines; but in these locations powders containing calomel, or the yellow oxid of mercury, or iodoform, xeroform, aristol, etc., are preferable and easier to use. A very good general application in these cases is black wash; it can be used as a gargle, or, diluted, as a vaginal douche.

Local Treatment of the Tertiary Cutaneous Symptoms.—Here again general surgical principles must guide us; cleanliness, avoidance of irritation, and prevention or reduction to a minimum of the added infections that cause so large a part of the symptomatology of these affections.

THE PAPULAR AND TUBERCULAR TERTIARY LESIONS.—When non-ulcerated, these lesions must be protected and treated gently. Careful bandaging and dressing with mercurial plaster or ointment is the best. When the lesions are ulcerated the crusts must be carefully removed after softening with olive oil, the ulcerated area cleansed with peroxid solution, and a suitable dressing applied. This latter will vary with the site and extent of the lesion, the amount of inflammation and secondary infection, etc. As they run from a small broken-down tubercle to extensive gummatous ulceration, all the mercurial application recommended above—powders, ointments, and oils—can be employed. Perhaps the most generally useful is a wet dressing of the bichlorid, 1 to 1,000. When there is marked pus infection the various iodine preparations, aristol, xeroform, iodol, etc., should be used in ointment or powder form. One measure has done me good service in a few cases when the tertiary ulcerations were on the face or around such an orifice as the nose, or threatened important organs, as the eyelids. It is the subcutaneous injection into various points of the skin nearby of a few drops of a 1 to 1,000 bichlorid solution. Its local effect seems to be excellent.

Local Treatment of the Tertiary Lesions of the Mucosæ and the Mucocutaneous Junctions.—These appear in the form of moist papules, mucous patches, and ulcerations, and are to be treated on the same principles as similar lesions appearing in the earlier stages. Boric acid, hydrogen peroxid, permanganate of potash, or bichlorid solutions for cleansing and antiseptis, with nitrate of silver or chromic acid applications for obstinate lesions, are in order. In bad cases the mouth or tongue may be so much affected as to interfere with eating. It may then be necessary to paint the mucosa with a cocain or eucaïn solution before each meal. The reader is referred to the section below for the treatment of certain special tertiary symptoms.

Local Treatment of Special Secondary and Tertiary Syphilitic Lesions.—Certain luetic symptoms, from their frequency or importance, require special attention to their treatment. Some are peculiar to the earlier, and some to the latter, stages of the disease, but most of them may appear at any time during its course.

MUCOUS PATCHES.—These common phenomena are most frequent in early lues, but may appear at any time, and are sometimes very obstinate. In addition to the measures detailed under the general heading above, including the avoidance of all irritation and the use of antiseptic mouth washes or vaginal douches, the patches themselves may be swabbed daily with tincture of iodine, or a 10 per cent. silver nitrate, or a strong potassium permanganate solution. If the patches resist this medication, as they often do, stronger caustics, chromic acid pure, or even a 1:800 sublimate solution will have to be employed. These applications must be made with great caution; otherwise serious and unnecessary damage may be done. Especially is this the case when the patches are upon the tonsils, velum, or pharyngeal vault, on account of the proximity of the glottis and larynx. The cauterization should be done accurately, with a small pointed wooden applicator, and with a minimum amount of fluid on it. Thus superficial and accurate cauterization can be done without any dropping on other parts.

Mucous patches of the genitals are common and dangerous; and here also cleanliness, antiseptic lavage, cure of any discharge, and treatment of any inflammatory complication that may be present is the first principle of treatment. Insufflation of a powder containing calomel, or even the pure drug itself, or combinations containing 10 to 20 per cent. of iodoform, xeroform, or aristol, are preferable in these locations to ointments. Cauterization is to be employed as in the mouth. In addition to these a mild bichlorid douche (1 to 10,000) should be used at least once daily.

Mucous patches also occur in other regions where the conditions of heat and moisture required to transform the syphilitic papule or tubercle into them are present, as under the breasts and between the toes in un-

cleanly persons. The principles of treatment are the same as for these lesions when on the mucosæ, except that I habitually employ pure calomel as the local application.

THE HYPERTROPHIC PAPULE OR TUBERCLE, OR CONDYLOMA LATUM.—These lesions occur around the genitals, in the axillæ, between the toes, and in other places where there is sufficient heat and moisture to stimulate the growth of the epidermal tissues, and yet not enough to macerate the surface and produce the mucous patch. The opposing surfaces should be kept separate, dry, and as clean as possible; which measures, with the employment of powdered calomel as a dressing, will usually suffice to cure them. Mercurial ointment is more effective but less pleasant. Under no circumstances must these exuberant growths be interfered with with knife or scissors; this would transform closed to open lesions, and mixed infection could hardly be avoided.

ALOPECIA.—Loss of hair occurs in syphilis under two circumstances: during the early period of the infection as a general defluvium affecting all the hairy surfaces of the body, and, later, in isolated areas as the result of skin destruction from various ulcerative processes. The latter variety is, of course, irremediable, and is only amenable to treatment designed to prevent or limit the destructive process. The early general alopecia, affecting not only the scalp, beard, eyebrows, pubic and axillary areas, but also general surface in hirsute individuals, gives the characteristic “moth-eaten” appearance to the affected heads. Due to the general nutritive depression caused by the infection, in which the skin and its appendages participate, it is precisely similar to the alopecia that follows typhoid or scarlet fever, and is of as good prognosis. The more or less atrophied hair papillæ regain their health and vigor with the other tissues when the brunt of the first spirochete invasion is over. But the loss of hair is felt as a serious matter by many patients, more especially as the alopecia of the scalp, beard, and brows exposes them to comment and suspicion. A good deal can be done to improve the nutrition of the scalp and help the restoration of the normal pilous covering. The scalp should be vigorously shampooed twice a week at least with hot water and green soap, or an irritant antiseptic soap, as that containing sulphur and naphthol. The inclination of the patient, however, especially if a woman, is to avoid washing or even brushing and combing, since it seems to increase the falling. It must be explained to them that there are multitudes of hair sacs that contain detached hairs which are kept in place only by the adhesion of the shaft to the walls of the sac; that they have no root attachments, and are not growing; that they are lost already, and will inevitably be cast off in a short time, and that their remaining in the sac tends to prevent the development of new and healthier pilous structures. In addition to the shampooing, a good irritant lotion should be applied thoroughly once daily at least. A mercurial used for the purpose not only

does this but is an effective local antiluetic medication as well. My usual formula is the following:

R Hydrarg. chlor. corr., grain 1 (0.065 gm.).
Glycerini, dram $\frac{1}{2}$ (2.0 gm.).
Aquæ coloniensis.
Aquæ destillatæ, āā ounces 3 (90.0 gm.).

In case the hair gets too dry under this treatment a 10 calomel-white vaselin ointment can be sparingly used from time to time.

IRITIS.—Of fairly common occurrence in the earlier stages of constitutional syphilis, iritis is a serious occurrence, and demands vigorous treatment locally, in addition to the general medication. In all obstinate cases the assistance of an ophthalmologist should be invoked, if possible; for the affection may readily lead to serious damage of the eye. The main object of the local treatment is to get the pupil dilated as quickly as possible; failure to effect which will result in iritic adhesions and deformity of the pupil, with damage to vision. Atropin in 2 per cent. solution should be instilled into the eye as often as is necessary. Three times daily will usually suffice, but it may be necessary to make the instillations every two hours until complete dilatation is effected. After that has taken place a much less frequent use of the drops will suffice to keep the pupil large. In cases where there is difficulty in dilating the pupil and keeping it so I have found great benefit from the use of a fly blister on the temple of the side affected; and the resulting erosion may be kept open as long as is necessary by the use of some irritant application. I generally employ mezereon ointment for the purpose. If pupillary adhesions have already occurred, an attempt may be made to detach them by a vigorous employment of atropin as above, or by the use once daily of one or two drops of a 1 to 300 eserine solution.

ONYCHIA.—Inflammation of the nail bed or the periungual tissues is usually occasioned by the development of specific papules, etc., in these locations, and subsequent pus infection leads to chronic ulcerative processes in the falx, nail bed, and the surrounding tissues. Uninfected lesions under the nail itself do not require treatment. At the margins of the nails pus infection and ulceration usually occur; and deep and persistent inflammatory processes may occur. Cleansing with peroxid solutions, and dressing the affected member with mercurial, citrin, or white precipitate ointment, are effective; but, if there is much pus formation, a bichlorid wet dressing is best, being antiseptic and antiluetic at one and the same time. Exuberant granulations must be cut down with silver nitrate, the actual cautery, or the knife; and, if the nail itself interferes with treatment or healing, evulsion of that appendage must be done.

PALMAR AND PLANTAR SYPHILIDS.—The thickness of the epidermis

in these locations sometimes masks the various eruptions that occur there either alone or as part of a general exanthem. On the other hand, this same factor and the necessary exposure of these parts to traumata of various kinds sometimes complicate the eruption with fissures, eczematous processes, and infections; and local treatment may be a matter of difficulty. The epidermis must often be softened and thinned by prolonged hot baths, scrubbing with green soap, etc., before effective local medication can be undertaken; it may even be necessary to apply a green soap poultice, or to soften the thick tissues with a dilute caustic potash solution beforehand. Of course, when there are fissures or excoriations, this energetic preparatory treatment cannot be undertaken. The most effective therapeutic applications in these locations are the various mercurial ointments, one of which must be selected in accordance with the severity of the lesions.

GUMMA.—A cardinal rule in the treatment of these tertiary manifestations of luetic poisoning is not to interfere with them in any manner which favors opening and added infection. The best ending for a gummatus accumulation is absorption, no matter where it is situated; and absorption can be brought about almost always, no matter how near the breaking-through point the softened mass may appear to be. Unfortunately the differential diagnosis between a softened gumma and an ordinary abscess is often not easy to make; and the temptation to plunge a bistoury into it and evacuate its contents is great. I have repeatedly seen gummata of such a structure as the palate, that were apparently on the point of rupturing, disappear under properly vigorous medication in a few days; and I have seen others quite unnecessarily opened, with resultant palatal perforation and all the troubles that that condition entails. Such being the case, there is but little local treatment to be used for the unopened gumma. I limit myself to painting the surface with iodine in weak solution, or with iodine-vasogen, or gentle inunction with a mercurial ointment. When rupture has occurred, and there is an open ulceration, mercurial applications in the shape of a calomel or other mercurial ointment or bichlorid wet dressings are in order.

BONES AND JOINTS.—The periostitis and synovitis of early lues are treated on the general surgical principles appropriate to these affections, with the addition, of course, of vigorous internal treatment and local mercurial medication by means of ointments, plasters, etc. The later specific osteitis and arthritis are handled in the same way, though here, of course, the internal iodine medication in addition to the mercurial is of importance.

INTERNAL ORGANS.—In the nature of things, the diagnosis of syphilis of the internal organs must be difficult, and often impossible. Moreover they fall under the domain rather of the internist and the various specialists dealing with the organs concerned, who have the knowledge of and

experience with similar conditions of nonluetic origin. And, finally, they are not, in many cases, accessible to local treatment. Brief mention will be made here only of the kidneys, and that chiefly on account of their importance as the chief agents of elimination of the drugs universally employed in the cure of syphilis. Mercury and arsenic may both be renal irritants, and are naturally badly borne when these organs are defective. Besides this, a simple albuminuria occurs, though rarely, as a regular symptom of early syphilis; and a true or a gummatous nephritis is known in the later stages. Hence a regular examination of the urine should be a part of the routine of every carefully treated case of the disease. When symptoms of renal irritation or kidney disease occur, caution should be exercised in the exhibition of either mercury or arsenic, in addition to the usual dietetic and medicinal treatment of the affection. I generally prefer mercury in some mild form, like the tannate, by the mouth in these cases to the customary injection treatment.

TREATMENT OF SYPHILIS IN PREGNANCY

A serious responsibility confronts the physician when pregnancy occurs in a patient who is or has been syphilitic, or when the father of the expected child is in a like position. To some extent the welfare of the infant is in his hands. And the situation is usually complicated by the parent's unbelief in the possible existence of danger, or by the necessities of secrecy.

Of course, much depends on the thoroughness and care with which the infected parent or parents have been treated during the course of their infection. In many cases medication has been insufficient; and even when it has been satisfactory, and when, furthermore, even the serum test has given negative results, it would be hazardous to predict with certainty the safety of the pregnancy. The case is, of course, much worse when the latter event occurs during the active stages of the disease in either party.

It was formerly supposed that mercury was contraindicated in pregnancy, or at least that it had to be used with caution in that condition. Undoubtedly this latter entails additional stress on the various emunctory organs, and especially upon the kidneys; and may be regarded as a mild toxemia. We hesitate to put additional strain on the organs and on the system at large. But experience has shown that the best results, both for the mother and the child, are attained by disregarding these considerations. It has been abundantly proven that mercury properly administered harms neither mother nor child; but, on the contrary, is often the direct means of their salvation.

When either parent, at the time of conception, is actively syphilitic, the treatment of the mother should be continued throughout the entire

period of her pregnancy, delivery, and lactation, regardless of whether she shows active symptoms of the disease or not. It is rarely the case that circumstances permit the employment of the treatment of election, that by injection, during this time. We must usually have recourse to mouth medication; but this should be as active and thorough as possible. When the syphilis in the mother is old, when there have been previous miscarriages, still births, or the delivery of infected infants I endeavor to carry out the injection treatment, disagreeable as it is under the circumstances, as the best means at our disposal to enable the woman to give birth to a living and healthy child. Where, as is often the case, secrecy is necessary, and the fact of infection in the father and even in the mother herself has to be concealed, antiluetic medication may be given under the guise of other treatment. This can usually be done with the aid of the family physician. The "mixed treatment" can be disguised as an ordinary and needful tonic.

In every case then, in which syphilis is known or even suspected to have been present in either parent and no matter how long previously, it is wise to give mercury to the mother during her pregnancy. Properly administered it does not a particle of harm and it may do incalculable good. More than that, I make it a rule whenever possible to have my male patients who have had syphilis in the past take a mercurial course during the first year of their marriage, no matter how old their infection may be.

As to the employment of arsenobenzol in the treatment of syphilis in pregnancy I can say but little, experience in that regard being yet wanting. I should hesitate, however, in employing a poisonous medication of such potency in that condition. Certainly its results administered to the nursing woman for the treatment through her of an infected child have not been such as to encourage me in its use in these cases.

TREATMENT OF HEREDITARY SYPHILIS

Antenatal syphilis is necessarily treated through the mother. This has been considered above. There remain for consideration the heredo-syphilis that appears later, at birth, or soon thereafter, syphilis hereditaria tarda, appearing a number of years later; and, finally, various dystrophies or malformations which are recognized as the remote effects of the hereditary luetic infection. The treatment of these affections does not differ essentially from that of the acquired form of the disease; a fact that it is well to bear in mind with reference to the symptomatology also. Of course, the general management of these cases requires the modifications that the age and size of the patient, the delicacy of tissues, and the susceptibility of the patient entail.

Hygiene.—It may be taken as an axiom that a heredosyphilitic child, even when most seriously affected, has a good chance to survive under efficient treat-

ment if it is nursed by the mother; and that conversely its chances are bad, even if much less ill, if it has to be brought up on the bottle. In every case then, where it is at all possible, the infant should be nourished only at the mother's breast. This entails absolutely no danger to her; it being a well-established fact that a woman who has given birth to a syphilitic child is already infected and is immune from further danger. She may not show, and she may never have shown, any objective symptoms of the disease; but she cannot get a fresh infection, and her blood is generally positive to the serum test. So firmly is this, the Colles-Baumès law, established that I should not allow even a negative Wassermann test to interfere with the procedure recommended. It has also the additional advantage of permitting efficient medication of the nursing child through the infected mother.

There is still another course that can be pursued, though I mention it only to reject it. The infected infant may be nursed by a syphilitic wet-nurse. It would probably be practically impossible to obtain such a one when needed; and experience has shown that, when this has been done, the infected child has hardly done better than would have been the case under artificial nourishment. Of course, under no circumstances must an infected infant be nursed by a healthy woman. The almost inevitable result would be infection of the nurse.

The heredosyphilitic infant requires watching and especial care as regards cleanliness, feeding, and the regulation of all its functions. The genitals should be especially attended to as regards scrupulous cleansing, and it is well to use a mild calomel powder as a regular thing instead of the ordinary talcum. The mouth also must be kept in the best possible condition. Attention to these details will save much trouble, and will facilitate the treatment of lesions when they occur.

Medication.—This must be systematically carried out in all heredosyphilitic infants, no matter whether they show symptoms of disease or not. It may be effected indirectly, through the milk, thus treating both mother and child at the same time; but this is usually not enough. It is almost always desirable, and certainly always when symptoms are present in the infant, to administer direct medication to it also.

So far as my own experience goes, and it is as yet extremely limited, the indirect medication of the heredosyphilitic infant through the mother by means of arsenobenzol has not been satisfactory; the infants have died, perhaps on account of a slow and inefficient arsenic absorption through the milk. Nor can I recommend the direct administration of the drug to the child in the present state of our knowledge of the subject.

Mercury is the remedy for the hereditary as it is for the acquired form of the disease. The injection method of either the soluble or insoluble salts is not suitable for infants or children. Their muscles are too small and delicate, and the natural repugnance of both mother and child to a strenuous and painful medication must be reckoned with. I have used them, however, in exceptional cases and in emergencies, and in older children. The mercurial bath is the most suitable and efficacious manner

of administering the drug to infants. Their skin is delicate and absorptive, the gastrointestinal canal is not interfered with, and the therapeutic results are very satisfactory. The details of these baths have already been given under the heading of administration of mercury by the skin, and the reader is referred to the proper place for them. The infants should have a bath every day, or every other day. In addition to this, the skin should be used between times for absorption of the medicament. In mild cases 15 to 30 grains of Neapolitan ointment, or of mercurial ointment mitigated with equal parts of vaselin or white precipitate ointment, should be spread on a piece of gauze and applied next to the skin under the belly band, and renewed daily. In more severe cases the pure mercurial ointment should be used; and here inunctions of small daily amounts of mercurial ointment may be resorted to, the mass being rubbed into the soles of the feet, where the skin is less delicate and less liable to be injured. We are sometimes compelled to have recourse to the gastrointestinal tract. I always select the least irritant preparation possible; mercury with chalk in $\frac{1}{4}$ to $\frac{1}{2}$ -grain doses, or calomel, 1-10 to $\frac{1}{4}$ -grain, three times daily is usually well borne. Injections, as said above, are usually to be rejected. Yet I have used the soluble ones in very small doses in a few cases where gastroenteritis and severe mouth affections rendered buccal medication impossible, and baths and inunctions did not promise rapid enough results.

The iodids must be given with caution in heredosyphilis, on account of the susceptibility of the infant's mucosæ. The "mixed treatment" is chiefly valuable in tardy heredosyphilis; and the dosage of both drugs in it is regulated by the age and weight of the patient and the urgency of the symptoms presented. The latest dystrophies and malformations due to heredosyphilis are often but little amenable to the specific treatment. Like the latest effects of the acquired disease, the brain and spinal cord scleroses, their symptoms denote rather the after-effects of the tissue changes occasioned by the luetic poison than the actual presence of the syphilitic processes; and these tissue changes are apt to be permanent and are but little influenced by medication.

One last word as regards the treatment of hereditary lues: In no department of syphilotherapy are the therapeutic results more satisfactory. No matter how serious the condition, rapid and vigorous treatment can almost always cope with it. I have repeatedly seen infants suffering from the most malignant forms of heredosyphilis of the skin, mucosæ, bones, nervous structures, and internal organs recover. No infant which is born alive with heredosyphilis is hopeless.

AUXILIARY ANTILUETIC MEDICATION

Under this last heading I shall consider briefly certain therapeutic procedures that have been and are used in the treatment of syphilis other than those previously mentioned. Some of them are well known and useless; others are new and still unfried; and others, again, though valuable as adjuvants to the regular treatment, are not really part of the specific medication.

The Baths.—I refer here not to plain or medicated baths taken at home, but to the system of treatment in vogue at Hot Springs and other places here, and at Aix-la-Chapelle in Europe, in which baths are supposed to play the most important part. The bath habit, happily, plays but a small part in our therapeutics here; for, apart from the employment of certain chalybeate and arsenical waters, which appear to be useful adjuvants to treatment in certain cases, we have little faith in them. Certainly we have no reason to suppose that baths, whether of mud or anything else, and mineral waters that do not contain appreciable amounts of any medicament that will even indirectly influence the luetic poison, have any effect on the disease. I have reason to know personally that the actual therapeutics at Hot Springs is exactly the same as our own. Though stress is laid on the beneficial effects of the baths and the waters, the good results often attained are not due to them, but to the mercury, iodine, and arsenic given at the same time. Just as good or better results can be attained elsewhere. There are absolutely no reasons, save subsidiary ones, for sending a patient there. It is a convenient place of retirement for secret treatment, and for the patient who wants to get away from his family and friends on account of telltale lesions on exposed parts of his body; and the change of scene and habits, with the regular life enjoined, may do some good; but with this their usefulness ends. There are very few cases indeed in which all these things cannot be accomplished without the expense and trouble involved in a visit to the Springs.

Tonics.—The abuse of the mercurial treatment in the earlier stages of modern syphilotherapeutics led to a reaction against the drug. There arose a school of antimercurialists, who rejected the remedy entirely, and relied upon general tonic treatment and the use of innocuous, and useless, vegetable remedies, such as sarsaparilla. So far did the pendulum swing that the very worst effects of the infection were ascribed to the remedy employed to cure it, and bones riddled with specific osteitis were exhibited as examples of the dreadful effect of the metal. The school is dead now, and no sane therapist denies the value of the mercurial treatment to-day; but its teachings, as in all such cases, contained a modicum of truth. Mercury was given in overwhelming doses and for too long; and there are other procedures of use in the treatment of syphilis, though of very subsidiary value.

It is not a very uncommon experience in the syphilis wards of the City Hospital to have patients brought in in extremely bad condition, and sometimes even bedridden, with an infection that has been overtreated, with skin and bone lesions so extensive and serious that the patient is apparently in danger of dying of sepsis. Sometimes these patients have already received very large amounts of mercurial and iodine treatment of one kind or another, and show distinct signs of mercurialism and iodism. Now, stop all specific medication in such a patient, give him neither mercury, arsenic, nor iodine; administer no drugs at all save such mild tonics or laxatives, etc., as may be indicated; have all his lesions dressed with a simple boric acid wet dressing and kept scrupulously clean; and put him under the best hygienic conditions; and, behold, the lesions begin to clear up at once, sleep and appetite return, the general condition begins to improve, and recovery quickly sets in. I have seen instances in which such measures, without any other treatment at all, have resulted in the healing of most extensive lesions in three weeks, with a gain of 18 or 20 pounds in weight; equaling the most striking effects of the mercurial or arsenic medication. These cases are rare, it is true; most patients are suffering from too little or inefficient medication. But they do occur, and that fact will serve to impress upon us the importance of embracing every means in our power to improve the general condition of our syphilitic patients. I am firmly convinced that the course of a given infection, its severity or mildness, the appearance or absence of serious phenomena, depends as much or more on the patient's general condition, on his hygiene and life, as upon the dose of the poison with which he has been infected, or the specific strain of microorganism that has reached his system.

As regards the various substitutes, vegetable and alterant, that are still occasionally recommended instead of that laid down in the preceding pages, they are all to be rejected. None of them can take the place of mercury, arsenic, and iodine.

Opothrapy, Serothrapy, Vaccination.—In the light of modern biopathology there may be legitimate hope that, at some time in the future, methods of syphilotherapy on one of these bases may be elaborated; but, up to the present time, they have been entirely unsuccessful. The most hopeful is perhaps the first:

OPOTHERAPY.—Metchnikoff, Neisser, Finger, and others have endeavored to modify the evolution of experimental syphilis in the ape by the subcutaneous injection of the syphilitic virus, but without success. Brandweiner and Spitzer have used emulsions of chancre and indurated lymph gland material in the human subject. The former believes that he has gotten an attenuation of the infection; but the results of the latter were negative.

SEROTHERAPY.—Attempts at the prophylaxis or cure of syphilis by means of the blood serum of animals refractory to the disease, or that of

animals with old inoculations, or that of human beings in the tertiary and non-contagious stages of the affection have not met with success. Metchnikoff and Roux, by repeated inoculations of the virus in anthropoid apes, have gotten a serum with a certain amount of antivirulent action; but it was slight and inconstant. The results claimed to have been obtained by injecting the serum of vaccinated horses by Cippolina and Risso are doubtful and unverified.

VACCINATION.—All attempts to attenuate the syphilitic virus by physical or chemical means, or by passing it through various animal bodies, have been failures. As Neisser says : “Every virus produced a typical syphilis; and when a typical syphilis was not produced the virus was dead or was not effectively introduced. We never got an attenuated syphilis, or a syphilis that remained local only.”

CHAPTER XXV

TUBERCULOSIS

HERBERT MAXON KING

PROPHYLAXIS

GENERAL CONSIDERATIONS

It is only within recent years that there has been any effective organized campaign looking to the prevention of tuberculosis. The last decade of the nineteenth century witnessed the beginnings of the struggle, but no practical advance was made before 1900. Since then the movement has gathered force with each year, and the present outlook is very promising. As is inevitable in any great sanitary movement of the sort, much energy and money have been wasted, but, on the whole, efforts have been rightly directed and, in the main, have brought encouraging results.

The factors concerned in the spread and development of phthisis are many and complex. They involve more than the mere bacteriology of the disease. They bear upon almost every aspect of the life of the community—its housing, its social customs, its dietetic habits, its standards of intelligence and education, its industries, its cost of living, its public provision for the care of the sick, and its outside relations.

As the nature of the problems has become clearer, it has been possible to classify them under three general headings, namely: (a) Those which fall to the share of the government; (b) those which belong to private organizations, such as antituberculosis societies, and (c) those devolving upon the family and the individual.

Long before Koch's isolation of the tubercle bacillus, the infectiousness of phthisis was suspected, and as early as 1865 it was proved by Villemin by animal experimentation. The first laws of which we have any record looking to the prophylaxis of the disease were made in the Spanish city Valencia in 1689, making it compulsory to burn the bed and bedding of persons dying of phthisis. Similar laws were made in France and Italy somewhat later, but we have no record of results in these cases, and it is probable that they were not appreciable. At least we hear of nothing more being done for a century or more, and it is un-

likely that they were rigidly or consistently enforced. In fact, nearly all that was done prior to Koch's great discovery has little other than an historical interest to the student of to-day. To this statement, however, there is one striking exception. Long before the discovery of the tubercle bacillus the phthisis mortality had begun to decline in many countries, notably in England; and Newsholme has shown conclusively that, while this decline has been influenced by many factors, that which stands in most constant and conspicuous relation to it is the provision for the care and isolation of the consumptive. Wherever there has been most provision for the institutional care of phthisis, there the decline in the death rate from this disease has been most marked. Other factors there are which have a bearing, such as improved housing, better public sanitation, lower relative cost of living, etc., but, comparatively speaking, all other factors are negligible.

In England the provision for institutional care (isolation) of consumptives came about somewhat accidentally, in the sense that it was not intended to reach this class of individuals peculiarly, but in many cases the consumptive early became a pauper and was, therefore, relegated to the almshouse infirmary. So it happened that before the middle of the nineteenth century the almshouses became the refuge of a considerable proportion of this class of individuals. They were thus removed from contact with the open community, and, while no effort was made to prevent infection, and undoubtedly many non-tuberculous inmates were thereby infected, the community at large was in so far protected. The phthisis death rate in England is known to have declined since 1850 nearly fifty-four per cent., and this remarkable fact is probably traceable chiefly to this cause.

The knowledge of the experience of England in this respect cannot fail to be of great value in directing the future antituberculosis campaign in other countries as well as in England itself.

As has been said, very little in the way of concerted and effective public effort toward the prevention of tuberculosis dates back of 1900, although the movement began during the preceding decade. The campaign has differed in method somewhat in different countries, and it is yet too early to form conclusions as to the relative merits of the various methods adopted. It is difficult to estimate with accuracy the true value of any preventive measure in a disease so insidious in its beginnings and so chronic in its course as is tuberculosis, until many years, at least, have elapsed after the introduction of the measure. It is improbable, indeed, if the present generation will be able to place a true valuation upon any of the methods so far adopted.

PREDOMINANT CHARACTERISTICS OF ANTITUBERCULOSIS WORK IN VARIOUS COUNTRIES

In **England** the conspicuous feature of prophylaxis in tuberculosis has been, from the start, the isolation of the advanced case. Alms-house infirmaries were compelled early to admit them, and special hospitals for consumptives were established in England long before they were elsewhere. Brompton Hospital for Diseases of the Chest, for instance, one of the largest institutions of its kind in the world, was established in 1841. A seaside hospital for scrofulous children was founded at Margate on the south coast in 1796, and the Royal Hospital for Diseases of the Chest was established in 1814.

Within the past ten years a number of splendidly constructed and equipped sanatoria have been established, notably King Edward VII Sanatorium at Midhurst and the Brompton Hospital Sanatorium at Frimley, and there is at present pending a plan of National Insurance for the United Kingdom. In this proposed national insurance plan provision is made for the erection of sanatoria for consumptives in which those who are within the scope of the act are entitled to treatment for a period of four months. It is proposed to set aside a capital sum of six million dollars for the purpose of aiding local authorities in building sanatoria throughout England and Wales, Scotland, and Ireland. A fund of about four million dollars a year will be made available for maintaining these institutions as the most effective aid in the campaign against tuberculosis, but when not required a part of this fund can be used for educational purposes and research work.

Notification laws also obtain in parts of England, chiefly in the manufacturing centers. The dispensary system has not been largely developed, however, and without the latter notification loses much of its prophylactic value.

Nevertheless, it must be admitted that the fall in the phthisis death rate has been far greater in England than in any other country in Europe, and, since it is shown to have depended chiefly upon the segregation of advanced cases, it would seem that England had adopted the most effective means of prevention, even while neglecting some other no doubt important measures.

In **Scotland** the death rate of phthisis has declined forty-three per cent. since 1866. The keynote of prevention has been notification. Up to the summer of 1909 thirty-three of the total 313 local authorities for public health had adopted compulsory notification, and the communities so covered by this requirement constitute one-fifth of the total population of the country. In these thirty-three districts, as well as in many others which have not yet adopted compulsory notification, provision has been made for the segregation and treatment of phthisis. Provision

for isolation of advanced cases has existed for some time, as in England, under the Poor Law. More lately much has been done for this class by various municipalities. Of late there has been a growing policy to relegate the responsibility for the care of this class of consumptives to the public health authorities and dissociate it from the poor law—undoubtedly a step in the right direction. In the large cities the system has been further perfected by the establishment of dispensaries and a system of official inspection. Thus in some—and the largest—communities of Scotland there is a very complete organization beginning with the compulsory notification of all cases—the dispensary system with its visiting nurses or inspectors; the provision for the care and isolation of advanced cases, and finally sanatorium provision for the curable cases. Wherever such a system best prevails decrease in the phthisis death rate has been most marked—notably in Edinburgh and Glasgow.

Scotland owes much to Doctor R. W. Philip for his effective work in the prophylaxis of tuberculosis. To him, in great measure, belongs the credit of organizing the present antituberculosis crusade in Scotland.

In **Ireland** little has been done until recently to prevent the spread of tuberculosis, with the consequence that there has been an increase in the phthisis death rate of 18 per cent. since 1866. In 1908, however, the Tuberculosis Prevention Act was passed, making compulsory the notification of *open* cases of the disease; the establishment of dispensaries and sanatoria by the hospital councils, and the enlarging of the powers of control over the meat and milk supplies. For many years there has been a poor law in Ireland as in England and Scotland, but, owing to a different application of the law, segregation has not been nearly so complete. It is estimated by Newsholme that the total amount of segregation of consumptives under this law in Ireland has not exceeded one-half that in England, proportionate to the respective populations. This fact, in large measure, probably accounts for the non-decline in the phthisis death rate in Ireland over the period when it was most marked in England.

In **Germany** there has been a decided fall in the death rate from tuberculosis during recent years, notwithstanding that there are no special laws on the subject. There are, however, excellent general sanitary laws, which permit of application to tuberculosis, and these laws have been successfully employed to control the spread of the disease—notably as in the case of the sickness and invalid insurance laws.

Germany is the home of the sanatorium. The names of Brehmer and Dettweiler are associated with the origin of the sanatorium idea, which has been so widely adopted in recent years throughout the civilized world, and which has remained the chief feature in the antituberculosis struggle in Germany. There are many large and magnificently equipped sanatoria in great measure supported by the compulsory insurance institutions. These institutions, providing, as they have done, for the care,

treatment, and education of tuberculous invalids, have undoubtedly played a large part in the reduction of the mortality from phthisis. In 1909 alone these insurance institutions provided sanatorium treatment for 42,232 tuberculous patients. The application of the laws also permits of compulsory notification and the prohibition of phthisical persons from engaging in certain occupations, such as those of wet nurse, nursery maid, handling of dairy products, etc. They also permit of house disinfection, the isolation of advanced cases, and the ordinary police regulations governing spitting and the like. The food supply in Germany is also subject to rigid inspection. Much credit is due to the splendidly organized Imperial Board of Health for its excellent work.

In **France** there is comparatively little sanatorium provision, and until very recently scarcely any special provision for the isolation of advanced cases. The preventive work has centered about the protection of the individual during infancy and childhood. The Roussel law has for many years required that all persons having the care of infants be subject to medical inspection and examination, and that all wet nurses must pass frequent medical examinations. In many towns an effort is made to teach mothers the elements of hygiene, and in the larger cities dispensaries distribute sterilized milk to mothers of the poorer classes.

Philanthropic societies have done much in the way of "fresh air" excursions among the children of the poor, sending them for varying periods to the seashore or country and providing seaside hospitals for tuberculous children. There are sanatoria for tuberculous children at Ormesson (Seine et Oise), Villiers-sur-Marne, and Hendaye, besides twenty-four so-called marine sanatoria or seaside stations for tuberculous and predisposed children.

The department of health has supervision of all dairy herds. Suspected cattle are tuberculin tested and killed if found tuberculous, the owners being reimbursed for the loss. Milk adulteration is heavily punished.

Since 1907 consumptives have been excluded from the general hospital wards, and hospital authorities have been required to provide special wards or blocks for these patients. The outlook for the future in France is much brighter than it has been in the past, but up to the present there has been no demonstrable reduction in the phthisis death rate.

Denmark has always had a comparatively low death rate from tuberculosis. From 1903 to 1907 inclusive the mortality from all forms of tuberculosis was only 2 per 1,000, and from pulmonary tuberculosis only 1.5 per 1,000 (24). There exist in Denmark many and excellent laws regarding the disease.

Preventive measures are conspicuously directed to the control of *animal tuberculosis* and the prevention of infection from animal sources. These precautions naturally followed upon Bangs' demonstration that

by means of the tuberculin test and isolation of infected cattle animal tuberculosis could be practically exterminated.

The sanitary authorities are empowered to inspect and condemn, when necessary, dwellings, slaughter houses, the meat and milk supply, and the construction, equipment, and cleaning of all schools. Notification is compulsory. The disinfection of dwellings after death from tuberculosis or the removal of patients suffering from the disease lies within the discretion of the health department. Expectorating in public rooms and railway carriages is prohibited, and any medical practitioner may send to the department laboratories specimens of sputa for examination without charge. Children living under such conditions as are deemed injurious to health may be removed from their homes by the authorities, and boarded elsewhere. Overcrowding in factories and work shops is prevented by law. No person with open pulmonary or laryngeal tuberculosis is eligible for a situation in the public service, and educational matter on the dangers of infection and means of prevention in tuberculosis is widely distributed.

There is provision for the care and treatment of 2,200 tuberculous patients of the poorer classes in hospitals and sanatoria, which perhaps is greater in proportion to the population (approximately two and one-half millions) than exists in any other country.

All things considered, Denmark, in many respects, may be taken as a model by other states in the energy and completeness of its antituberculosis campaign.

Public measures for the prevention of the spread of tuberculosis now obtain in all civilized countries, and in most cases favorable results are already demonstrable.

In the **United States**, taken as a whole, it is difficult to estimate, with any approach to accuracy, the effect of the vigorous antituberculosis crusade of the last ten years. This is due to conditions that are peculiar to the country. Its vast territory is divided into many states, each of which, so far as concerns the present discussion, is practically independent, making its own laws and prescribing its own sanitary safeguards, and each having a more or less distinctive relation to the enormous flood of immigration, which has been going on in an unbroken and ever-increasing stream for the last sixty or seventy years. Many of the states are not yet comprised within the "registration area," which, of course, prevents a fair comparison of statistical returns.

So far the part taken by the Federal Government in the prevention of tuberculosis, as it affects the country at large, is comparatively small. The Immigration Exclusion Act applying to tuberculous individuals took effect in 1907. This prevents the entrance into the country of aliens presenting obvious symptoms of the disease, and provides for the deportation of any who develop tuberculosis within three years after their

arrival, but, as might be imagined, the exclusion cannot be made effective in cases where the general appearance of the individual is not conspicuously that of an invalid, and the number of consumptives actually turned back is consequently insignificant when compared with the total number of tuberculous persons.

Early in the general awakening of the people to the menace of tuberculosis the Public Health and Marine Hospital Service, a bureau of the Treasury Department, became active in the campaign. In 1898 orders were issued directing that separate wards be set aside in all marine hospitals of the service for the exclusive use of tuberculous patients, and in 1899, by executive order, the abandoned military reservation at Fort Stanton, New Mexico, was converted into a sanatorium for the treatment of tuberculosis among seamen of the Merchant Marine. In 1902 an executive order was issued, through the same bureau, prescribing the precautions to be taken on board ships of the Merchant Marine whenever tuberculosis was discovered among the crews.

Shortly after the establishment of the Marine Hospital Sanatorium at Fort Stanton, the War Department established a sanatorium for the care and treatment of tuberculous soldiers at Fort Bayard, New Mexico, another abandoned military post.

The Navy Department had shortly before established a small tuberculosis camp at Pensacola, Florida. This, however, has since been replaced by the Navy Sanatorium at Las Animas, Colorado, established in 1907, a former army post transferred to the Navy Department.

By order of the Central Government an investigation has been made into the prevalence of tuberculosis among the Indians, with a view of making sanatorium provision for the treatment of Indians afflicted with the disease. As a result of this investigation there are now five special hospitals on as many Indian reservations in which provision is made for treatment of tuberculosis.

The District of Columbia is under federal jurisdiction, and such governmental antituberculosis measures as have been adopted there, of course, emanate from the general government, but, as such measures have but a local bearing and do not affect the country at large, they should be classed among state rather than federal procedures. They include the usual police regulations regarding spitting; cleaning and airing of public buildings, etc., and, whenever possible, the separation of tuberculous employees from those who are healthy; the spread of literature and educational pamphlets among tuberculous employees, and the posting of copies of "Regulations to Prevent the Spread of Tuberculosis in Government Buildings, Offices, and Workshops." There is also some provision by the government for the segregation, care, and treatment of tuberculous invalids in the District of Columbia, but up to the present very inadequate.

With the exception of the few prophylactic measures briefly sum-

marized above, and which constitute but a small fraction of the effective governmental control of tuberculosis in the United States, the federal authorities have done nothing. By the very nature of things the burden of responsibility has necessarily devolved upon the separate states. Each state is obliged to work out its own problems and adopt such preventive measures as its legislators see fit, or leave the whole matter to private philanthropy and lay organizations. Thus the progress which has been made in the fight against tuberculosis varies in a marked degree in the different states.

In the majority of the states some legislation bearing upon the tuberculosis problem has been enacted. In about three-fourths of the states circulars of general information regarding the causes, prevalence, and means of prevention have been issued and more or less widely distributed by official action of the respective boards of health.

In many of the states notification is technically compulsory, but in most instances it has been impracticable to enforce the law except in the large cities. Vital statistics are very generally collected throughout many of the states, and are available for the past ten years or more in the states within the registration area of 1900, which area comprised Connecticut, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. Up to 1910 the registration area had increased to include eighteen of the forty-six states of the Union, exclusive of the District of Columbia, besides fifty-four cities outside of the state registration area.

It is obvious that in the absence of reliable vital statistics little accurate knowledge of the rise or fall of either the general death rate or that from any particular cause is possible. For this reason it is impossible to make a statistical study of the incidence and mortality of tuberculosis over any extended area of the United States for any considerable period of time. To the great credit of *Massachusetts*, however, there are available in the records of that state very accurate statistics relating to births, marriages, and deaths since 1842. From these records it is learned that the phthisis death rate has fallen in Massachusetts more than fifty-four per cent. since 1850, notwithstanding the fact that no special legislation was enacted prior to 1898, when the Massachusetts State Sanatorium at Rutland was established. It is interesting to note, however, that as early as 1857 there was some institutional provision for the care of consumptives (Channing Home, Boston), which was extended in 1861 and again in 1864. These institutions, limited in capacity as they were, almost necessarily reached only advanced cases, thus removing to that extent foci of infection from the communities in which the patients lived. The relation between segregation and a declining phthisis death rate is again illustrated.

From the start segregation has indeed been the prime feature of

the antituberculosis struggle in Massachusetts. It was the first government in the world to establish a state institution for the exclusive care and treatment of tuberculosis. Notification is not even yet compulsory throughout the state, although it is so in all of the cities and the larger towns. There are numerous other preventive measures, especially in Boston, looking to the education of the public as well as the tuberculous invalid, and there are many and efficient dispensaries, day camps, "classes," etc., besides the usual educational exhibits and literature. But above all in importance, and undoubtedly bearing the most direct relation to the decline in the phthisis mortality in Massachusetts, is the provision for the segregation, care, and treatment of the tuberculous invalid.

New Jersey was the second state in the Union to collect and record vital statistics, and the records are very complete since 1879. They show a decline in the tuberculosis death rate, though to a much less marked degree than is the case with Massachusetts. Notification was made compulsory in 1905. In 1903 a law was passed making spitting in railway carriages a misdemeanor.

The State Sanatorium at Glen Gardner was established in 1907; otherwise, such measures for the prevention and segregation of the disease as obtain in the state are due to private organizations.

Pennsylvania was a non-registration state until 1906. It is, therefore, difficult, if not impossible, to determine its phthisis death rate prior to that year. But to Pennsylvania belongs the honor of possessing the first antituberculosis organization in America. The credit for initiating the movement is due to Doctor Lawrence Flick, who, with a few enthusiastic friends, organized the Pennsylvania Society for the Prevention of Tuberculosis, the first society of its kind in the world.

Notification is now required by law throughout the state, but beyond this governmental control of the disease is confined to the municipalities. As the death rate from tuberculosis (all forms) is but little over 1.5 per 1,000 population, it is fair to assume that a substantial reduction has taken place.

Flick was the first to draw public attention to the dangers of "house infection," and the fight in Pennsylvania has chiefly centered around this idea. Numerous dispensaries and sanatoria have been available as a means of prevention and treatment for the past ten years through well directed private philanthropy, so that here, too, segregation is one of the chief agents employed among preventive measures.

Michigan has been included within the registration area since 1899, and its vital statistics were, therefore, accepted for the Twelfth Census in 1900. This state has the distinction of being the first to pass a law requiring notification of cases of tuberculosis. The State Board of Health succeeded in effecting the passage of this law in 1883, but it was a "dead letter" until very recently, and the recorded statistics, so far as con-

cerns the phthisis death rate in Michigan, are probably of little value. As they stand they show, by a wide margin, the lowest death rate of any state in the Union, or, indeed, in Europe—quite too low to be accepted without stronger verification than is forthcoming.

At present Michigan is second to Massachusetts only in the energy and efficiency of its state control of tuberculosis. In 1905 the legislature made provision for the establishment of a state sanatorium, and in the same year passed a law requiring that instruction be given in all public schools on the modes by which communicable diseases are spread and the methods for preventing or restricting them. Long before this, however, the State Board of Health issued frequent "Teachers' Bulletins" with a view to prophylaxis, especially in tuberculosis. The State Department of Agriculture is also energetic in the matter of tuberculosis among cattle and the production and distribution of clean milk.

Hygienic education is the conspicuous feature of the campaign in Michigan, while at the same time there is increasing provision for segregation and treatment of the consumptive.

The first essential in the state control of tuberculosis is notification. This is now so generally recognized that in most of the states, especially of the registration area, some form and measure of notification is practiced. In some it is voluntary, hence incomplete; in others, Massachusetts, for instance, it is not required by state authority, but is locally compulsory in the larger towns and cities. Almost every state board of health recognizes its importance, and where it is not already compulsory is striving to make it so. Without data regarding the incidence and mortality of the disease there can be no economy of forces in the work of prevention, and this applies with particular force to state and municipal control.

Of the value of compulsory notification and the various institutions contingent upon it the experience of every community in which it has been enforced bears indisputable evidence. In most of the larger cities of the United States municipal ordinances looking to the control of tuberculosis are in force. As a rule, they antedate the prophylactic measures of the states and generally determine the policies of the latter.

Whenever municipalities have pushed a vigorous campaign of prevention the results have been gratifying. This is especially true in the case of the *City of New York*, which not only probably has the most complete system of control of tuberculosis of any city in the world, but where the results in the reduction of the mortality of tuberculosis, and hence probably the morbidity of the disease, are phenomenal. The results which have been accomplished in New York are the more remarkable when the inherent difficulties of the problem as they affect this, the largest city on the continent, are considered—as, for instance, the enormous increase in and the heterogeneous character of the population;

the areas of densely crowded tenements; the migratory habits of a large part of its people, representing, as they do, nearly every nation and language in the world; and the inevitable poverty and ignorance which prevail in certain sections.

The credit of the undertaking and the brilliancy of its results are due very largely to the labors of Doctor Herman Biggs, the general medical officer of Greater New York.

In 1881, with a population of less than 1,250,000, New York had a phthisis death rate of 4.27 per thousand inhabitants. In 1910, with a population which had increased to more than 4,800,000, the phthisis death rate had been reduced to 1.81 per thousand inhabitants, a fall of more than fifty per cent. The means for accomplishing this result were not, of course, available from the start. The Department of Health in New York had the same prejudices to overcome and the same doubting public to convince as is the case in other communities, only on a larger scale; and the present excellent system is but the outgrowth of a patient and persistent struggle over a quarter of a century.

The present method followed by the Department of Health is as follows: "Circular of Information Regarding the Measures Adopted by the Board of Health for the Sanitary Supervision of Tuberculosis in the City of New York, 1911:

"1st. All cases of pulmonary tuberculosis occurring in the City of New York are registered at the Department of Health.

"2d. Every person suffering from pulmonary tuberculosis is furnished with instructions as to the measures to be taken to prevent its extension. When there is no private physician in attendance these instructions are given by nurses of the department, who visit the patient at regular intervals.

"3d. All premises which have been occupied by persons suffering from pulmonary tuberculosis are, when vacated by death or removal, disinfected either by fumigation by formaldehyd or by renovation.

"4th. Charitable assistance is provided, so far as is possible, for all cases wishing or requiring such assistance. Hospital care in the most suitable institution for the individual case is provided through a central admission bureau conducted by the Departments of Charities and Health, and Bellevue and Allied Hospitals.

"5th. Patients not under a physician's care are furnished treatment and advice at the tuberculosis clinics of the department.

"6th. The general public is educated as to the nature of the disease, the precautions to be taken against its spread, the advisability of institution and sanatorium treatment.

"7th. Specimens of sputum from residents of New York City are examined for the presence of tubercle bacilli."

The results of the notification law as concerns New York City are

considered very satisfactory. It is estimated that about 85 per cent. of all living cases of tuberculosis are now reported to the health department. The non-reported cases fall into three groups: (a) patients of the better class whose physicians fail to obey the law; (b) those of the poorest class who have no attending physician, and (c) unrecognized cases.

The entire city has been divided into thirty tuberculosis districts, each having its own tuberculosis clinic to which patients may go for examination, advice, and treatment free of charge. The objects of these clinics are as follows:

"(a) The medical care and supervision of all cases of tuberculosis applying for treatment; thorough instruction as to the dangers to themselves and others, and as to the necessary prophylactic measures; the provision of medicines and sputum cups.

"(b) The continued observation at their homes of all indigent, needy, and ambulatory cases and those discharged from the public institutions of the city. Nurses detailed for this special purpose visit such patients at their homes, see that instructions are carried out, and that the sanitary surroundings are satisfactory.

"(c) The provision of a municipal institution to which all cases of tuberculosis may be referred by the various charitable organizations throughout the city, and from which suitable cases may be referred to various public institutions for their care.

"(d) The prompt recognition of incipient cases, so that they may be sent as early as possible to sanatoria outside the city.

"(e) The supplying of proper food, in the form of milk and eggs, to favorable, indigent cases."

The provision for the segregation and treatment of the tuberculous poor in New York includes city hospitals for advanced cases, country sanatoria for the earlier and curable cases, and day camps.

School children found to have open tuberculosis are excluded from the public schools, and for predisposed and sickly children provision is made for open air schools.

The work of the Department of Health is substantially augmented by private charitable organizations and philanthropic societies, chief among which are the Tuberculosis Committee of the Charity Organization Society, the Brooklyn Bureau of Charities, and the Association of Tuberculosis Clinics. The whole campaign is so well organized and co-ordinated as to effect the best possible results with the greatest economy. The expenditure of energy and money, vast as it is, is insignificant when compared with the brilliant results attained.

In many other American and European cities excellent preventive measures are taken, involving, as in New York, coöperation between their respective departments of health and private organizations, with very sat-

isfactory results in the prevention of tuberculosis, but in no other city has the plan of operation been so perfected and the practical value of the system so efficiently demonstrated. So that, as far as the municipal control of tuberculosis is concerned, New York stands a world model.

From very recent statistics, gathered from reliable sources, and furnished the writer by Mr. Frederick L. Hoffman (statistician of the Prudential Insurance Company), the actual reduction in the phthisis death rate from 1881-1885 to 1906-1910, in a few of the principal cities of the world, is shown to have been as follows:

New York.....	from 3.98 to 1.97, or 50.5%
London	from 2.22 to 1.32, or 40.5%
Paris	from 4.41 to 3.74, or 15.2%
Copenhagen	from 2.73 to 1.36, or 50.2%
Vienna	from 6.85 to 2.74, or 60. %
Budapest	from 7.15 to 3.40, or 52.4%

Recent data from Berlin are not available at this time (August, 1911).

The slight apparent discrepancy between these figures and some quoted above is explained by the different limits of the periods included and the difference in methods employed in collecting the data.

In a personal communication Mr. Hoffman writes:

"During the five years ending with 1910 the mortality of Copenhagen from tuberculosis was 1.36 per 1,000. Cities with lower average rates than Copenhagen and for the same period were the following: London, 1.32; Edinburgh, 1.14; Sydney, N. S. W., 0.72; Melbourne, Victoria, 1.09; Rotterdam, 1.27; The Hague, 1.24, etc. Cities with rates only slightly in excess of the Copenhagen rate were the following: Glasgow, 1.40; Amsterdam, 1.38; Hamburg, 1.37, etc. Cities with rates more or less considerably in excess of the Copenhagen rate were the following: Dublin, 2.68; Belfast, 2.35; Paris, 3.74; Stockholm, 2.30 (partly attributed to a change in the system of classification of the causes of death for 1908-1910); St. Petersburg, 3.01; Moscow, 2.58; Berlin, 1.88; Dresden, 1.80; Breslau, 2.71; Munich, 2.26; Vienna, 2.74; Budapest, 3.40; Trieste, 3.69; Milan, 2.20; Turin, 1.83; Rio de Janeiro, 4.02; and New York, 1.97.

"These rates are derived from the annual summary of marriages, births, and deaths prepared by the Registrar-General of England and Wales.

"I am seriously apprehensive that all of these rates are more or less impaired in accuracy for comparative purposes by want of uniformity in medical diagnosis and the classification of the causes of death."

Anti-tuberculosis Societies.—Within the last few years there have come into existence many semipublic and private associations for the purpose of combating the spread of tuberculosis. In almost all of the older states such societies have been organized, while there is at present scarcely a town of any considerable size in the United States but has its antituberculosis association, either independently or as a prominent committee of its charity organization. There is at present a growing tendency toward a more or less close federation of these bodies, and a mutually profitable interrelation with the National Association for the Study and Prevention of Tuberculosis.

The National Association was organized and a constitution adopted in June, 1904, at a meeting in Philadelphia, with a charter membership of about 150 physicians and laymen. Its membership in 1911 was 2,210, representing all sections of the United States. A conspicuous feature of the National Association is the large number of its lay membership, whose interest has done much to make its work effective. Meetings are held annually and the proceedings of the association are published. To facilitate the work at its meetings the association is divided into five sections, as follows: sociological; clinical and climatological; pathological and bacteriological; tuberculosis in children; and surgical.

The headquarters of the National Association are in New York City. Doctor Livingston Farrand is the executive secretary.

Since 1901, when the British Congress on Tuberculosis became an international affair, six international congresses on tuberculosis have been held, making in all seven. The sixth congress was held in Washington in 1908. The Seventh International Congress was held in Rome in the spring of 1912. These conventions are made up of national organizations, and, independent of political or governmental control, they have become a world-wide coöperative society, whose function is the study and prophylaxis of tuberculosis. It is quite impossible at this time to estimate the value of this vast organization, but that it has been great, not only through the efficiency of its constituent and allied local societies, but through its influence in shaping governmental control of tuberculosis, is beyond question. It has been through the efforts of these associations that the movement has become popularized and awakened such a wide and practical interest in preventive medicine among the laity.

GENERAL PROPHYLACTIC MEASURES

House Infection.—Tuberculosis is notoriously an indoor disease. Infection in the open air probably rarely, if ever, takes place. Direct sun's rays quickly destroy the virulence of the tubercle bacilli. Twitchell found that bacillary sputum exposed to direct sunlight for seven hours was incapable of producing a lesion, but retained its infectivity under ordi-

nary bedroom conditions (carpets, woolen blankets, etc.) after thirty-nine days.

Dry dust containing tubercle bacilli retains its infectivity for a much longer time. Collected from bedrooms, it has been found to be infectious after four months (25). In dark, ill ventilated, and poorly lighted apartments dried sputum probably retains its infectivity for longer periods. An apartment vacated by a careless consumptive may, therefore, remain a source of infection to succeeding tenants over a considerable period, if thorough disinfection or renovation is neglected.

Means of Disinfection.—Chemical disinfection of premises previously occupied by tuberculous invalids is of doubtful efficacy if not followed by thorough scrubbing and cleansing, but in the case of dwellings should be practiced as a preliminary measure. The most effective fumigation is by means of formaldehyd gas. The contents of the apartment should be moved out from the walls, mattresses placed on edge, clothing hung loosely on lines, rugs lifted from the floor, and everything so arranged as to permit the freest exposure to the gas. All openings should be sealed with paper strips, which may be obtained from drug supply houses or from the local health department. As a rule, the local health department takes charge of chemical fumigation, and follows the method prescribed by its health officer, usually without charge to the tenant or owner. The method practiced by the department in New York City is as follows: For every 1,000 cubic feet of room space 500 gms. (one pound) of quick lime, 250 c.c. (eight fluid ounces) of formalin, 40 per cent., and approximately 90 c. c. (three fluid ounces) of commercial sulphuric acid are required. The formalin is first mixed with half its quantity of water and the sulphuric acid slowly added. The quick lime is placed in a suitable receptacle (one which will stand heat) which is then raised from the floor on bricks or metal support, and when all is ready the formalin mixture is poured quickly over the lime and the door left for exit closed and sealed. Water should not be left in the apartment during fumigation by this method. The apartment should remain closed for at least twelve hours and then be thoroughly scrubbed.

The New York Health Department requires renovation—renewal of wall paper, calcimining, or painting—when conditions indicate the necessity—e. g., evidence of previous neglect, broken wall surfaces, torn paper, or other conditions which do not permit of satisfactory cleansing. Undoubtedly *thorough scrubbing* with warm water and soap, to which lysol or chlorinated lime has been added to the volume of two per cent., is the most important part of the process. No fumigation of itself should be considered sufficient, and if reliance must be placed upon a single measure let it be, by all means, renovation or thorough mechanical cleansing in the manner indicated.

The *alkaline disinfectants* in the case of tuberculosis are preferable,

especially when any considerable quantity of sputum is to be treated. The various phenol and mercuric bichlorid solutions are apt to coagulate the superficial layers of sputum and retard, if not prevent, disinfection of the deeper parts.

Cuspidors are best disinfected by means of a ten per cent. solution of *caustic soda*, which, however, injures furniture, floors, and woodwork, and, therefore, has a limited usefulness.

For general use in *wetting down* walls, ceilings, floors, and furniture a 2 per cent. solution of *chlorinated soda* or *lime* is efficient, although its volatility renders it disagreeable. A 2 per cent. solution of *lysol* is effective and unobjectionable.

After death from tuberculosis *personal clothing, bedding, etc.*, unless it can be disinfected by *live steam under pressure*, had better be burned. Such articles as can be thoroughly boiled, however, are thus safely treated.

Workshops.—Next to the tenement house and the unhygienic apartment, the overcrowded workshop is probably one of the most prolific sources of tuberculosis infection. There can be no doubt that laws governing conditions in shops, factories, and other industrial plants should be carefully made and rigidly executed. A wise proprietor or manager of any large mercantile or industrial concern will maintain a regular sanitary inspection and make a practice of excluding “coughers” or other individuals with open tuberculosis from common workrooms. Such a practice is probably as much to the interests of economy as to those of hygienic precaution.

Corporations.—In large corporations, where several thousands of persons are employed in a single building or group of buildings, it has been found advantageous to maintain a dispensary and infirmary. In the few instances of this sort with which the writer is familiar such an institution has proved of great value, not alone on the grounds of sentiment and humanitarianism, but as an economical measure as well. The early recognition and exclusion of tuberculosis among employees are made possible by such a plan.

Tuberculous children should be excluded from the *public schools*, and rigid school inspection should be practiced at frequent intervals. A *cough persisting* for more than one or two days should be a sufficient reason for temporary suspension from school. *Sanitary drinking fountains* (without cups) should be provided in all school buildings. In the more modern school buildings ample air and window space is a matter of regulation. In the older buildings where special ventilating apparatus is wanting teachers should see to it that no opportunity is lost to renew the air in the school room by opening the windows, whenever it can be done without subjecting the pupils to undue exposure. The same rules which apply to tuberculous pupils should be enforced in the case of teachers,

and no tuberculous teacher should be permitted to continue his or her duties while there is present an open lesion.

Conveyances.—Railway coaches and passenger steamships are probably less a menace to health, so far as concerns tuberculosis, than is popularly supposed. Nevertheless, some of the older practices should be discontinued. The common drinking cup is objectionable, and in some instances has already been replaced by cheap paper cups to be obtained from conveniently placed slot machines. The practice of brushing the clothes of passengers when nearing their destination is an abomination and should be forbidden.

Sleeping cars should be thoroughly disinfected, cleansed, and aired at the termination of each trip. The ordinary cuspidors used in railway coaches are unsatisfactory, since in a moving train it is about an equal chance that expectoration will go on to the floor. Passengers should be required to carry their own sputum receptacles. The wash rooms of sleeping cars should be provided with a special basin for use in cleansing the mouth and teeth, and notices posted forbidding the use of the wash basins for such a purpose.

Removal of dust and dirt from railway coaches should be effected by means of a vacuum cleaning apparatus. The old method falls into the category of dangerous (dusty) trades.

In 1902 the Marine Hospital Service issued the following circular, applying to ships of the Merchant Marine (this order has been found efficacious) :

“In order to aid in the prevention of the spread of tuberculosis among seamen of the merchant marine, the following rules will be observed whenever practicable:

“Whenever a seaman suffering from tubercle of the lungs applies for treatment at a relief station of the service, the medical officer or acting assistant surgeon in charge thereof shall notify the master or accredited agent of the vessel on which said seaman sailed immediately preceding his application for relief, and, if said vessel is in port, shall, with the consent and aid of the master, owner, or agent of the vessel, disinfect the forecabin or other apartment previously occupied by the aforesaid seaman.

“The method of disinfection shall be as follows:

“1. Thorough mechanical cleansing of floors, walls, and bunks with hot water and concentrated lye.

“2. Wetting floors, walls, and bunks with either of the following solutions:

Solution 1

Carbolic acid	1 part
Water	100 parts

Solution 2

Corrosive sublimate	1 part
Hydrochloric acid	2 parts
Water	1,000 parts

“Forecastles should be painted or whitewashed after disinfection when practicable.”

Insects.—It is well known that the ordinary house fly is a frequent conveyor of typhoid infection, and there can be little doubt that flies and other insects may be a source of danger in tuberculosis. A house or an apartment in which consumptives are domiciled should be screened and every effort made to exclude flies from the neighborhood of the invalid. Such precautions are especially needful in the country, where flies are apt to be most abundant and where the dangers arising from them are most frequently ignored.

Dogs, cats, and other domestic pets are likewise a source of possible danger in the presence of a tuberculous invalid, and should not be permitted.

INDIVIDUAL PROPHYLAXIS

Protection of the child against tuberculosis should commence in early infancy and should be unremitting, irrespective of whether there is tuberculosis “in the family” or not. Parents and guardians should recognize a very real and a very serious duty in this regard. They should understand, moreover, that such precautions as are needful in respect to tuberculosis are, after all, simple and easy of execution, and, if conscientiously carried out, will go far toward protecting the child against most other infections. It is by no means necessary nor advisable to carry these measures to the absurd extremes sometimes practiced, and which often make ridiculous the whole scheme of prevention.

But certain rules there are which, if consistently and persistently followed, promise all that is possible in the protection of the individual from infection through infancy, childhood, and adolescence—the periods in life of greatest susceptibility. It must be acknowledged that ideal precautionary measures cannot be applied universally and with equal promise of success in all cases. The mother of a rapidly increasing family forced by financial necessity to attend unaided to all the household duties cannot be expected to devote the same time and care to her children that might be reasonably expected in the case of the well-to-do with small families; but, even here, the essential precautions are possible, and in so far as they are recognized carry with them the obligation.

The duty and responsibility in respect to hygienic instruction in all cases lie with the family physician. It is a matter of common observa-

tion that, even among the very poor and ignorant, the doctor's instructions, if given in plain language and freed from ambiguity and unnecessary complexity, are carried out very fully and conscientiously, and many cases of failure may be traced to the inapplicable character of the instructions given.

Protection of the Infant.—The presence of 'open tuberculosis in the family or household is sufficient to justify the most scrupulous and painstaking precautions. In such cases the infant should be, as far as is possible, isolated. When this is impossible, as is too often the case, the affected member or members of the household should be rigidly excluded from any contact with the infant. This rule applies with particular force to parents. Kissing or unnecessary fondling of a baby is objectionable under any circumstances, but on the part of a tuberculous invalid is positively criminal.

When the mother is tuberculous and yet is compelled by necessity to assume the personal care of the child, she should, of course, be fully instructed as to the dangers of infection and the means to be adopted for preventing it. The need for frequent careful cleansing of the hands and face, the wearing of such clothing as will permit of easy washing and sterilization by boiling, the necessity of holding gauze or paper handkerchief before the mouth when coughing, and avoiding all unnecessary contact with the infant should be constantly emphasized.

But, where it is possible, it is much to be preferred that all personal care of the infant, bathing, dressing, etc., should devolve upon a healthy person, and none other should occupy the same sleeping apartment with the child. In large families among the poor, and especially in tenement housing, a separate apartment for the infant is seldom possible. Whenever it is, however, it should be the rule, and in any case the infant should be kept in a clean, well lighted and ventilated room, with the maximum opportunity for fresh air and sunshine. Carpets, upholstered furniture, hangings, and all unnecessary furniture should be removed. From earliest infancy a child should be accustomed to the open air at all seasons. This does not imply harsh exposure or other extreme practices, and care should be always observed in the matter of clothing and wraps appropriate to the weather conditions. Such cloths or sponges as may be used for cleansing purposes, especially such as are used about the face and hands, should be the exclusive property of the infant, and under no circumstances should the handkerchief of another be employed for such a purpose. Frequent bathing of an infant is necessary, but bathing oftener than once a day, except perhaps in very hot weather, is probably harmful in some cases and is beneficial in none.

FEEDING.—It must be conceded, of course, that the mother's milk is the ideal and by far the safest food for the infant, but, where the mother is sickly or frail, or weakened by too frequent child bearing, nursing is

certainly inadvisable. When there is a suspicion of tuberculosis, active or latent, or supposedly "cured," the danger of infection through the milk is a possibility, and, though denied by some, is too real to permit it under any circumstances, and it should be uncompromisingly forbidden. The next best recourse is a healthy wet nurse, but in America at least this is seldom practicable, and the only alternative is artificial feeding. With modern methods of modification cow's milk is, in the vast majority of cases, the best and most conveniently obtained substitute for mother's milk. But here again the danger of tuberculous infection must be borne in mind and guarded against. There is no longer a doubt that bovine virus is pathogenic for man, particularly in early life; and, when the source of the milk supply is unknown, or the methods of handling and delivery are not positively beyond suspicion, some method of sterilization is imperative. In small communities, where it is known that the herd from whence the milk supply comes is tuberculin tested at frequent intervals, and where other precautions are taken to protect the herd against disease, where it is known that no person with open tuberculosis has anything to do with the handling of the milk, and where the latter process is carried out under modern approved conditions, there can be no objection to the use of the raw milk in infant feeding, and no doubt there are some advantages in the use of untreated milk for this purpose. But, generally speaking, it is rare that one can feel any certainty on such points, and then sterilization is the only safe course.

Pasteurization.—Of all the methods up to the present advanced for this purpose, Pasteurization is by far the most satisfactory and freest from objection. It has been sufficiently proved that tubercle bacilli and indeed most pathogenic organisms are killed by a temperature of 60° C. (140° F.) maintained for twenty to thirty minutes. Milk so treated is not robbed of its nutritive properties to an appreciable extent, nor is it otherwise made unsuitable for infant feeding, while at the same time it is sufficiently sterilized. The method is a simple one, easily carried out by any one who can read a thermometer, and requires so little in the way of apparatus that there is no reasonable excuse for neglecting this safeguard even among the very poor. It must not be forgotten, however, that sterilized milk is no less susceptible of contamination than is raw milk if it is carelessly handled and left exposed after pasteurization—a point to which attention should always be drawn.

With the growth of the infant and its ability to take other food than milk, it is necessary to caution the mother or attendant against indiscretion, which may lead to digestive and nutritional errors—often the precursors of tuberculosis in the sense of lowered resistance to infection. The practice of feeding an infant from another's dish and with another's fork or spoon is reprehensible, and, as in the case of wash cloth or sponge, the napkin or bib should be the infant's exclusive property.

GENERAL CARE.—When the infant has learned to creep and move about, further care is needed to guard against infection from floor dust. Where it is not possible to give the child a separate apartment and a bare, clean floor, a clean sheet or other covering should be spread upon the carpet and the babe confined to the space thus protected. Since almost everything that an infant can pick up or handle comes in contact with its mouth, it is wise to select its toys with a view to convenient and frequent cleansing. The practice of keeping the child out of doors during most of the day should begin in infancy, and, as the intervals of feeding become longer, the total time spent in the open should be correspondingly greater. Even in crowded sections of the cities this is no longer a difficult matter, since, with the use of roofs and fire escapes for this purpose, a comparatively clean and safe means is afforded.

In this connection the adaptation of the roof of an urban dwelling, or even a tenement house, to the requirements of an outdoor life for



FIG. 1.—ADAPTATION OF ROOF OF A CITY HOUSE TO THE REQUIREMENTS OF AN OUTDOOR LIFE FOR CHILDREN. (William P. Northrup, M. D.)

children is worthy of consideration. An ingenious scheme of this sort has been devised by Doctor William P. Northrup of New York City, an illustration of which is given in Fig. 1.

Throughout early life watchfulness is necessary to detect signs of physical abnormalities, the prompt correction of which is most desirable. Especially important is the removal of any obstruction to normal respiration. Pharyngeal adenoids are common in early childhood and frequently

lead to irreparable mischief if neglected. Mouth breathing is a significant symptom, and is usually traceable to this cause.

Particular care should be exercised during and subsequent to the common diseases of childhood, and especially the exanthemata. Cervical adenitis should be traced to its source and the cause removed whenever possible. [The same may be said for all forms of enlarged glands. Even when the cause cannot be removed the glands should be treated.—Editor.] The tendency to catarrhal attacks is sufficient to justify every care. Such susceptibility in a child always suggests poor resistance, respiration abnormalities, and nutritional errors. A persevering "outdoor treatment" in such cases will go far toward restoration to the normal.

It is held by some—Major Woodruff, for instance—that exposure to the direct sun's rays is injurious. Be this as it may, a prolonged exposure to direct sunlight during the warm weather is certainly uncomfortable even for an adult, and the infant should be protected against it. When the means is at hand for sleeping out of doors, on properly protected porches or balconies, it is no doubt an excellent practice and at least unobjectionable; but when elaborate effort has to be made, at the cost of convenience to the rest of the household, the advantages to be gained are by no means commensurate with the trouble. When, however, there is reason to suspect a predisposition on the part of the child, or there is a history of exposure to infection, no pains should be spared to inure the child to an open air life day and night.

With the development of the child to an age of understanding, a sufficient amount of hygienic instruction can, with a little care and tact, be introduced to make even a very young child a valuable auxiliary in its own protection, although it must be confessed no great reliance can safely be placed upon this point. Most young children are prone to "eat their peck of dirt" if given the opportunity. Nevertheless, something may be gained by repeated properly directed admonition.

With the advent of school years more can be accomplished. In many public schools there is at present a wisely conceived plan of hygienic instruction as a part of the curriculum from the primary grades upward. It does not invariably work out satisfactorily, and has been known in some instances to result in most absurd and grotesque conceptions on the part of the young mind, but the plan on the whole is a good one.

In many parts of the country antituberculosis societies have issued leaflets applicable to children, and there can be no doubt that in many instances these have served an excellent purpose.

Knopf's Schedule of Rules for School Children is very generally adopted, and has been found satisfactory in being easily understood and applied by the child of average intelligence, even in the lower grades:

DR. KNOFF'S RULES FOR CHILDREN

"Do not spit except in a spittoon, a piece of cloth, or a handkerchief used for that purpose alone. On your return home have the cloth burned by your mother, or the handkerchief put in the water until ready for the wash.

Never spit on a slate, floor, playground, or sidewalk.

Do not put your fingers into your mouth.

Do not pick your nose or wipe it on your hand or sleeve.

Do not wet your fingers in your mouth when turning the leaves of books.

Do not put pencils in your mouth or wet them with your lips.

Do not hold money in your mouth.

Do not put pins in your mouth.

Do not put anything in your mouth except food and drink.

Do not swap apple cores, candy, chewing gum, half-eaten food, whistles, bean blowers, or anything that is put in the mouth.

Peel or wash your fruit before eating it.

Never sneeze or cough in a person's face. Turn your face to one side or hold a handkerchief before your mouth.

Keep your face, hands, and fingernails clean. Wash your hands with soap and water before each meal.

When you don't feel well, have cut yourself, or have been hurt by others, do not be afraid to report to the teacher.

Keep yourself just as clean at home as you do at school.

Clean your teeth with toothbrush and water, if possible, after each meal; but at least on getting up in the morning and on going to bed at night.

Do not kiss anyone on the mouth or allow anybody to do so to you.

Learn to love fresh air and learn to breathe deeply and do it often."

A child, it must be remembered, requires much sleep—ten hours is none too much up to adolescence, and it is always wise to insist upon a regularity of habit in this respect, as in all others that pertain to a child's daily routine. There is little danger in overdoing calisthenics and all outdoor exercise at this age, and these should be encouraged. The generality of children are not prone to overstudy or mental concentration, yet exceptions are sufficiently common to justify a note of warning in this regard. Modern educational methods with children are probably not ideal, and with a very conscientious child impose a dangerous strain which must be guarded against.

For tuberculous children or those who have been exposed to infection, or are presumably predisposed to the disease, there have recently been established in some cities in this country and abroad open air schools.

These have proved a success wherever they have been tried, and the plan merits a wider adoption. One of several such schools established in the New York public school system largely through the efforts of Doctor John W. Brannon is illustrated in Figs. 2 and 3.



FIG. 2.—FRESH AIR CLASS FOR ANEMIC CHILDREN, PUBLIC SCHOOL 21, MOTT STREET. The first established in the Public School buildings of New York City. Midwinter. (Courtesy of John W. Brannon, M.D.)

To what extent the young boy or girl shall be instructed in matters of the sexual perversions common to that age is a delicate and difficult question. Undoubtedly the wise parent is the proper person to advise, but often such a matter is beyond the tact and judgment of the parent where the boy is concerned. In such cases the family physician can usually be of the greatest service as an adviser.

Children should have a cleansing bath at least once, and preferably twice, a week, and should be taught early the value of a morning sponge, shower, or plunge bath. Swimming is an excellent and healthful form of exercise, but easily carried to excess, especially with boys given the opportunity. In short, almost every form of exercise in the open air is beneficial, and should be encouraged during the years before adolescence. At the same time careful instruction along the lines indicated is helpful and protective, and, if given with judgment, free from objections. One must, however, bear in mind that childhood is the most impressionable period of life, and in all instruction and admonition the greatest care

needful to avoid producing morbid impressions of the pathologic. It should be the rule to encourage the child in, and emphasize the value of, doing what is healthful rather than to point out the dangers of doing what is unhealthful.

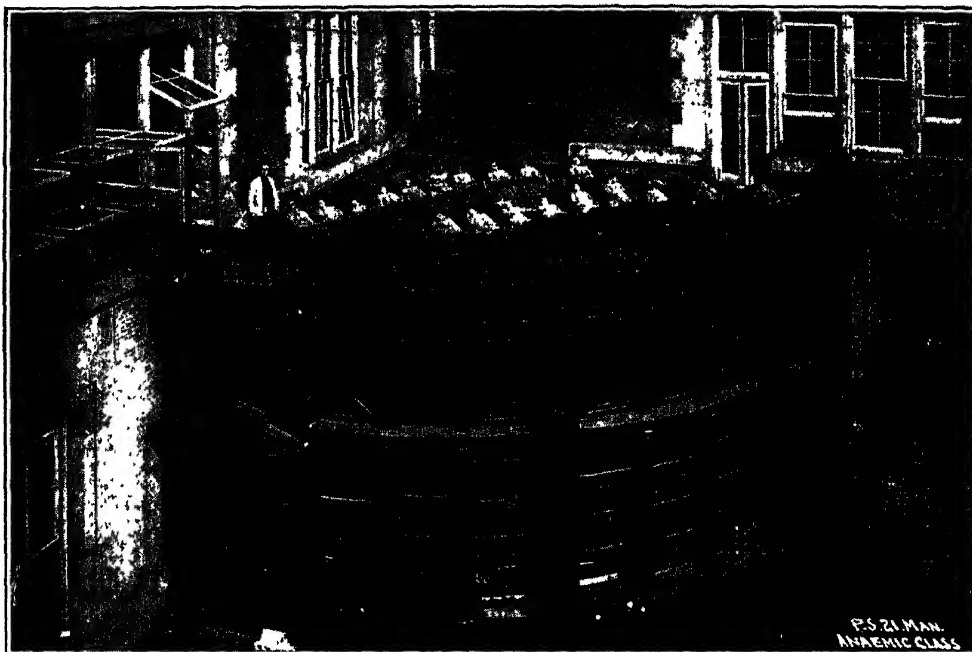


FIG. 3.—REST HOUR IN PUBLIC SCHOOL 21. Spring. Classroom to the left. Note the pivoted windows. (Courtesy of John W. Brannon, M.D.)

Youth.—With the passing of adolescence the problems of prevention assume a somewhat different aspect. Contrary to the habits of childhood, those of youth tend to excess, both mental and physical. Overstrain is an acknowledged predisposing factor in many diseases, and a frequent precursor of tuberculosis.

A conscientious student is very apt to neglect necessary outdoor recreation and to develop a sedentary indoor life—itself dangerous enough, but which, when coupled with ambition for school or college honors, becomes a real menace to the health of the youth. On the other hand, quite as serious a menace is the modern method of competition for athletic honors, the more so perhaps because it appeals to the taste of the larger class of student folk. The development of tuberculosis following more or less closely upon severe athletic training is a matter of frequent observation. It is a common fallacy to imagine athletes to be comparatively immune to infection. On the contrary, it is probable that susceptibility is increased by severe physical exercise, and is known to be so where this is carried to excess.

In one division of Loomis Sanatorium, during five years ending October 31, 1910, of 857 patients treated in all stages of the disease, 59

(6.8 per cent.) gave a definite history of severe athletic training previous to the development of the disease.

It is unnecessary to more than mention the dangers of youthful intemperance in the common vices of that period. Fortunately, the use of alcohol and even of tobacco is becoming to an increasing extent unpopular, and, for whatever reason this be so, it is a much more powerful deterrent to the youth than any amount of advice based solely upon hygienic grounds. Sexual excesses, late hours, and dietetic errors are dangers which do not threaten youth as seriously as they do a somewhat later period of life, but, of course, should be guarded against at any age. Every boy and girl should early have it instilled into their minds that the most perfect physical and mental development of which they are individually capable depends absolutely upon a clean, regular, and well balanced life. They should be early taught that, while it is possible for them to survive abuse and excesses over perhaps a considerable period, each and every indulgence of this sort will leave an ineradicable scar, and to just that extent prevent the highest development of both mind and body. Continued indulgence will inevitably break down the strongest constitutional resistance, and open the doors to invalidism, among the protean forms of which none is more common than tuberculosis.

Occupation.—In America the choice of an occupation is within the capacity of most young men and women. Fortunately, science has done much to mitigate the dangers of many occupations formerly classed among those inimical to health, so that with the healthy and robust there is comparative safety in leaving the selection to the tastes of the individual; but when there is a predisposition to tuberculosis, or a suspicion of a possible latent infection, the choice of a life work becomes an exceedingly important matter.

It is always wise to remind the youth about to enter upon a vocation that, in most cases, barring certain really dangerous occupations, the nature of his employment is of less importance to health than is the character of his recreation. In other words, that sixteen hours devoted to sleep and healthful outdoor recreation, properly balanced, will more than offset any ill effects from eight hours' work, almost irrespective of the nature of the work. One whose occupation is of a sedentary character should cultivate a taste for out of door exercise during the hours of recreation. An occupation involving close mental application should be balanced by recreation as far as possible differing in character, and, per contra, work involving physical strain should be balanced by suitable mental diversion. Every professional man or woman will find it advantageous to cultivate some innocent hobby or fad. The diversion is stimulating and restful, and cannot fail to promote health and immunity.

The onset of tuberculosis is not infrequently sudden and without recognizable premonitory signs, and, in such cases, aside from following

a general hygienic rule of life, it cannot be guarded against. On the other hand, there is usually a train of more or less characteristic phenomena antedating the development of the disease. These should be recognized by the physician as at least ominous, and it is far better to prescribe strict precautionary measures when they may not seem absolutely necessary than by neglect of such precautions to permit the development of the disease.

Digestive disturbances and loss of weight, a feeling of lassitude, fatigue on comparatively slight exertion, a tendency to frequent catarrhs of the air passages, anemia, loss of appetite, and irritability of temper are symptoms which appear so frequently in the early history of the consumptive, prior to the development of recognizable disease, that they are by some taken to indicate the incipency of tuberculosis rather than predisposing factors to the disease. Be that as it may, their development in the first few decades of a strenuous business or professional career, or during student life, should be considered of sufficiently serious importance to justify radical changes in the life and habits of the individual.

Marriage.—It is difficult, if not impossible, to control or regulate domestic relations, and marriage in particular, by any rule of health, desirable as it might be in theory to do so. The science of eugenics has not yet progressed so far as to appreciably influence the laws of affinity even among the most enlightened of mankind. From time to time legislators, with more zeal than perspicacity, have endeavored to pass laws preventing the marriage of the unfit, but have naturally failed. Such problems cannot be solved by legislative enactment. Yet the question is constantly put to the physician: is the marriage of a healthy person to one who has or has had tuberculosis permissible? And it is by no means an easy question to answer. As relates to prophylaxis, there are two points only to be considered: (a) the effect upon the healthy party to the marriage, and (b) the effect upon the progeny. As to the former, open tuberculosis is an infectious disease, and marriage in such a case involves a prolonged and constant exposure on the part of the healthy individual. On the other hand, a closed lesion completely arrested or healed does not involve any known risk to the healthy. So far, then, as concerns the first point, one should advise uncompromisingly against marriage in the case of open tuberculosis, but may sanction it in the case of a closed or healed lesion when a sufficient test of time justifies the belief that the healing is permanent.

As to the second point—the effect upon the progeny—so vast a field for discussion is opened by the questions which are thus raised that it is quite without the capacity of this article to consider them. The present mind on the subject is, almost without exception, agreed that tuberculosis is not hereditary in the ordinary meaning of the term, although

the researches of Schmorl and Kockel (26), and more recently of Warthin and Cowie (30), prove that placental tuberculosis is not only an observed fact, but probably of not infrequent occurrence in the case of a tuberculous mother. Whether the bacillus can be transferred readily from the placenta to the fetus, however, is doubtful. In any case the direct transmission of the bacillus from the mother to the fetus is so rare as to be practically a negligible factor. In the case of a tuberculous father the chance of transmission is far more improbable and has never been demonstrated. This phase of the subject, however, is of less practical importance than is the question of transmission of organic defects from parent to child—defects which are not easily discernible nor obviously traceable to the parent, but which are sometimes characterized by an apparently lessened resistance to infection as the child develops.

The recent statistical investigations of Mr. Karl Pierson strongly indicate that the frequency of tuberculosis among the children of tuberculous parents is greater than can be satisfactorily explained by infection independent of some organic predisposition or inheritance, and, in short, that the progeny of tuberculous parents have not the same chance for physical robustness and resistance to disease that obtain among the children of healthy parentage. On the other hand, it is not uncommon to see a family of apparently strong, healthy children of a tuberculous mother reach maturity without developing an apparent tendency to the disease. These are points which should be frankly made clear whenever the question is raised of marriage between persons one or both of whom are tuberculous.

Precautions to Be Observed in the Presence of Tuberculosis.—

A conscientious and properly instructed consumptive, who is not helpless, is a safe member of a household. Such an one will instinctively avoid exposing others to infection by the observance of certain precautions and the avoidance of unnecessary personal contact, especially with young children. On the other hand, a careless, uninstructed, or unscrupulous person, with an open tuberculous lesion, is a constant source of danger to all about him. Invalids whose disease has progressed so far as to make them comparatively helpless are also a source of danger, however well intentioned they may be, although in such cases the danger zone is, by reason of their close confinement, much more circumscribed. It occasionally happens that through a mistaken sense of kindness or delicacy healthy members of a family fail to insist upon the carrying out of proper precautions for fear of hurting the feelings of the invalid, even when the latter is really anxious to conform to the necessary rules of safety. In such cases, of course, the same danger exists as with the careless consumptive.

Following are the simple rules and safeguards adopted to prevent infection in every well-conducted sanatorium. They have proved over a

long period of time to be efficient in preventing the spread of the disease from the sick to the well, even where the contact is necessarily close and constant, as it must be in such institutions:

(1) All sputum and other excretion arising from or coming in contact with a possible disease focus must be deposited in a suitable receptacle, which can be easily and thoroughly cleansed and sterilized or, preferably, burned.

(2) Since the droplets of mucus and saliva expelled by the act of coughing, sneezing, and, in some instances, laughing and talking are known frequently to contain tubercle bacilli and are consequently capable of conveying infection, a gauze or paper handkerchief should be held before the mouth always when coughing and sneezing, and, in the cases of certain individuals, when talking or laughing, and such gauze or paper handkerchief promptly collected and burned by the attendant at least once daily.

(3) Toothpicks, fruit cores, cigar and cigarette butts, and all other articles coming in contact with the mouth must be deposited with the sputum and destroyed with the latter.

(4) The use of a toothbrush and antiseptic mouth wash and gargle, at least two or three times daily, is strongly recommended. They should be used over a toilet or other vessel intended for the purpose, and never over a wash basin or bath tub.

(5) The hands and face should be frequently washed with warm water and soap and the nails kept short and clean.

(6) Men are advised to shave the beard and mustache or at least to wear them clipped short, to prevent the lodgment and retention of particles of sputum thereon.

(7) When there is reason to suspect a tuberculous involvement of the bowels or urinary tract, a separate vessel should be used to receive the discharges and the latter disinfected before being deposited in the common toilet basin.

These rules apply to the acts of the patients themselves, and are evidently sufficient to prevent direct conveyance of infection.

There are other duties, however, which devolve upon the attendant, or in the case of the home upon the housekeeper, and which are almost as important in the process of safeguarding the healthy who are obliged to come into more or less close contact with the sick.

Dishes and Eating Utensils.—In the case of a bedridden patient whose food is served separately individual utensils, napkins, etc., should be used, and cared for separately, although this is not necessary if it entails much inconvenience, and, when the invalid can take his or her meals with the rest of the family or in a public dining room, it is not necessary

to have an individual service. It has been shown (J. Woods Price) that there is no danger of infection from dishes and eating utensils if they be thoroughly cleansed with hot water and soap, such as is done by every careful housekeeper. Such articles as can be immersed in boiling water should, however, as a matter of special precaution, be so treated.

If napkins are used for more than one meal they should be carefully kept by themselves in a paper or linen envelope rather than a ring, to avoid contact with the napkins of others.

Bedding and Personal Clothing.—When woolen blankets, quilts, or other bed covering are used, which cannot be frequently subjected to sterilization by heat, a strip of cotton or linen covering should be fastened by safety pins or basting to the edge nearest the patient's head and changed as frequently as is required. The counterpane or outside covering should be of washable material.

Laundry.—All articles of personal clothing, bedding, napkins, etc., which have come in contact with the patient should be handled as little as possible and not put into the general "wash" until they have been carbolized, subjected to live steam or boiling water, or otherwise disinfected. Meantime they should be deposited in a cotton, linen, or paper bag suitable for the purpose. When such precautions are observed, there is no danger of infection on the part of laundry workers.

Sweeping and Dusting.—An apartment occupied by a tuberculous invalid should be frequently cleansed. "Dry sweeping" is, however, most objectionable. If the floor is covered by a carpet and a vacuum cleaner is not available, the carpet should be moistened, preferably with an antiseptic solution, and a wet broom used. In the case of a bare floor it should be wiped with a damp cloth. The walls, picture rail, window ledges, furniture, etc., should also be wiped with cloths dampened with an antiseptic solution. The use of feather dusters is objectionable in any case, and removal of dust should always be effected by means of a dampened dust cloth. Whenever possible, a vacuum cleaner is preferable to other means for superficial cleansing of an apartment.

The effectiveness of the measures for protection which have been outlined will depend, of course, upon the intelligence and conscientiousness with which they are carried out in any case. Wherever they have been faithfully executed they have succeeded over a period of many years in preventing the infection of healthy attendants, physicians, nurses, and servants in institutions devoted to the treatment of all forms of tuberculosis, and they are no less applicable in the home and boarding house than in the institution, although it is obviously more difficult to enforce them in the former.

TREATMENT

GENERAL CONSIDERATIONS

"In many diseases physicians may safely adopt, as the result of their experience, a routine practice, chiefly modified by the degree of violence in the symptoms. It is not so in phthisis; for there is no malady which assumes so many protean forms, and is attended by such diversified complications" (Samuel Morton, 19).

Morton might have added that there is no disease in which apparent brilliant success in treatment is so frequently followed by discouraging relapse, and none in which an apparently hopeless situation more often results in a spectacular improvement.

The incipency of the disease is often hidden in a long train of vague symptoms, sometimes extending over many years; while, again, it breaks upon an apparently normal individual with the suddenness and violence of an acute infection. In either case the disease is apt to follow a varied course of alternate exacerbations and arrests through a long period.

There is no disease which more sorely taxes the fortitude and constancy of the patient, or the equanimity and forbearance of the physician.

Prognosis in tuberculosis is notoriously uncertain both as to final outcome and duration of disease.

It is by all means essential, therefore, that at the very beginning of treatment the relations of physician and patient should be established upon a firm basis of mutual understanding. Nothing is to be gained and often much that is vital to the patient is lost by making light of the infection no matter at how early a stage it is discovered.

At best treatment will necessarily have to be extended over a long period of more or less tedious and expensive inactivity. It cannot be assumed that any case, however mild, is cured in less than two years after all symptoms of the disease have disappeared. This should be borne in mind by the physician and early impressed upon the patient. It is the first requisite to intelligent medical advice in such cases.

The factors upon which advice and treatment will depend in any individual case are, in the order of their importance:

- (a) The stage and duration of the disease.
- (b) The financial condition of the patient.
- (c) The social condition, previous habits, and the temperament of the patient.
- (d) The patient's age.

With a clear understanding on these points the physician is in a position to advise to the best advantage whether the patient is to be

- (1) Sent to a sanatorium.
- (2) Treated at home.
- (3) Sent to an "open" health resort.
- (4) Treated at a dispensary, or
- (5) Treated in a hospital.

Whether he is to be separated from his family and whether he is to be permitted to attend in whole or in part to his business.

There is no known specific for tuberculosis. Each case presents individual requirements, which will to some extent modify the treatment. Individualization is, in fact, the keynote of success in whatever course is prescribed. This is no less true in the sanatorium than in the home or in the dispensary.

The essential elements in the treatment of tuberculosis are:

Open air life.

A suitable régime of rest and exercise.

A properly balanced generous diet suited to the individual, and the treatment and management of symptoms and complications.

To which may be added special measures, such as tuberculin in suitable cases; topical remedies, such as medicated inhalations; mechanical procedures, etc., and the employment of vaccines other than derivatives of tubercle bacilli.

The whole to be constantly and rigidly under an intelligent medical supervision.

Selection of Cases for the Sanatorium.—Every patient, from whatever walk in life, presenting a reasonable prospect of material improvement or "arrest" of the disease should, if possible, be given the advantage of at least a preliminary course of treatment and instruction in a sanatorium. In no other way will he so readily learn the value and rationale of strict adherence to a régime. It has been urged against the method that there is provision for but a small percentage of all suitable cases, and that, therefore, it is one which is not generally applicable. But within the past few years a great number of such institutions have been established, especially in America, so that, while there is still lacking adequate provision, it is possible to extend the benefits of the sanatorium to a much larger number than was formerly the case.

The stage and duration of the disease will, of course, determine the eligibility of a patient for sanatorium treatment. As a rule, the earlier the stage and milder the symptoms the more favorable is the case for the sanatorium, but there are many patients with advanced and long-standing lesions, yet with excellent constitutional resistance, who, if they have not already had a sanatorium training, will greatly benefit by a few months in the institution; results in this class are often most gratifying. On the other hand, far advanced febrile and acute cases, and those which present tuberculous or other complications requiring indefinite bed treatment,

should not be sent to the sanatorium at least until a remission of symptoms, under hospital or home management, justifies it.

Happily, financial considerations are no longer a serious hindrance. There is available now in almost every country an increasing provision for sanatorium treatment of the poor—as a rule, near their homes; while the well-to-do may be sent to more distant private institutions. The social condition likewise offers little or no obstacle, so far at least as concerns an “educational” sojourn in the sanatorium.

The age of the patient is of more significance. Infants are best treated at home, if the environment and other conditions permit; otherwise in a hospital. Young children up to puberty require special care and attention. Educational features should form a part of the institutional régime in such cases; while other special measures adapted to the peculiar requirements of the child make it advisable to treat tuberculous children in special institutions rather than in regular sanatoria. Children, on the other hand, respond very favorably to suitable institutional care and treatment, and should be given the benefit of such wherever suitable institutions are available.

Patients past sixty years of age are unsuitable, as a rule, for sanatorium life and discipline. The ordinary routine is difficult and irksome to old people, and in the majority of these cases the “game is not worth the candle.”

Lawrason Brown considers as favorable for sanatorium treatment, in general, all “incipient” and “moderately advanced” cases; patients with slight tuberculous complications, such as superficial ulceration on one vocal cord; slight interarytenoid thickening; fistula in ano; patients with slight constitutional disturbances, but extensive physical signs due to pleurisy. He considers as unfavorable for the sanatorium patients under fifteen and much over fifty years of age; all “far advanced” or hopeless cases; patients with serious tuberculous complications or with albuminuria; diabetes; a persistent diazo reaction; chronic diarrhea; melancholia, profound neurasthenia, or pregnancy; former patients who have relapsed; those with pronounced symptoms out of proportion to physical signs; persistent tachycardia or pyrexia; those who have steadily declined since the onset with continued loss of weight in spite of hyperalimentation, and those with marked dyspnea on slight exertion; patients with lesions extending over more than one lobe, and those with cavity (4).

Latham believes that it is difficult to lay down rules as to cases unsuitable for sanatorium treatment. He contends that each case should be judged on its individual merits, and that much depends upon the character of the home surroundings. But he would exclude cases with extensive excavation in both lungs; cases with persistent diarrhea, high fever, and great debility—at least until these symptoms have yielded to treatment at home. Patients should also be excluded who are suffering from

chronic alcoholism and those who have severe cardiac complications, albuminuria, or diabetes (15).

The following plan governing the admission of patients to the Adirondack Cottage Sanitarium has been in force for the past ten years or more:

First, is ascertained the duration of the disease and whether the patient has or has not steadily declined since then. Second, the present status of the patient is noted with particular reference to the amount of fever, sweats, cough, and expectoration. Third, chief importance is attached to rational symptoms rather than to physical signs.

Those favorable for admission are: (a) pleuritic cases; (b) patients with fair nutrition and slight impairment of health; (c) cases beginning with hemoptysis, without constitutional impairment; (d) incipient cases.

Those unsuitable for admission are: (a) cases which have steadily declined since onset; (b) cases showing a preponderance of constitutional impairment over comparatively slight physical signs; (c) those presenting complications, especially laryngeal, glandular, intestinal, bladder, renal, or joint affections; (d) all septic cases showing type of periodic hectic fever.

All sanatoria aim to receive, as far as possible, early, mild, and uncomplicated cases. The best results are doubtless secured with such patients, but it has been long recognized that more advanced cases and those presenting some of the less serious complications often do very well under sanatorium treatment, and whenever possible such patients should be given the advantages of a trial at least in the sanatorium.

Patients whose disease is extensive and obviously progressive, with marked cavity and fever which does not tend to subside with absolute rest, are certainly not suitable for sanatorium life, and should be cared for at home or in a hospital. On the other hand, excellent results are often obtained in cases with extensive physical signs and even considerable excavation when the constitutional resistance is good, and there is a fairly prompt response to rest in the open air and suitable diet. An "arrest" of the disease in such cases may be looked for under sanatorium treatment. The same is true with regard to certain complications which were formerly considered as contraindicating treatment in the sanatorium, as, for instance, tuberculous laryngitis. It is true that an extensive infiltration, with or without ulceration, causing more or less edema of the mucosa, dysphagia, and painful deglutition, is an extremely serious complication and is seldom amenable to any form of treatment. On the other hand, moderate infiltration and ulceration, especially when confined to one side of the larynx and unattended by symptoms which interfere with nutrition, are very common complications of pulmonary tuberculosis, often passing unrecognized and frequently yielding to simple treatment and rest. Such complications should not, therefore, contraindicate sanatorium treatment, where, as a rule, the patient will enjoy the best opportunity for

recovery and where the complication may be most conveniently treated. Glandular complications also are not necessarily prohibitive. Cervical adenitis often yields to a hygienic-dietetic treatment alone, and unless very extensive is an indication for tuberculin treatment in connection with sanatorium régime. Slight albuminuria is present at some stage of the disease in about one-half of all cases. When transitory and unaccompanied by casts, it is probably not of serious significance; in fact, it is, in many instances, due to dietetic indiscretions arising from hyperalimentation and can be best controlled in an institution. *Albuminuria with casts* constitutes a more serious and significant complication, and yet one which is not uncommon.

Of the last 307 cases discharged from one division of Loomis Sanatorium prior to August, 1911, sixty-seven (21.8 per cent.) had albumin and casts in the urine, either temporarily or constantly, during residence. Of these sixty-seven only nineteen made any lasting improvement under treatment.

In a sanatorium in which there is adequate infirmary or hospital provision many patients who would otherwise have to be rejected may be admitted for a period of observation before final decision. Such a plan works out very satisfactorily and merits a wider adoption.

One thing must be borne in mind, however. The sanatorium is not a suitable place for bedridden, hopeless, or seriously complicated cases. When there is ample hospital or infirmary accommodation, as has been said, a trial may be given acute or apparently progressive cases with the hope that the régime and the change of environment will effect a substantial betterment. If the latter is not promptly forthcoming, however, the patient should be sent home or to a hospital adapted to the care of such cases, and it is a still better plan to make the initial effort at the home or the hospital for advanced cases, and then, if it proves effective, to send the patient later to the sanatorium. Such a course will often save the patient and his family painful disappointment and a fruitless journey.

To sum up, then, every tuberculous individual presenting no prohibitory symptoms or complications should be given the undoubted advantage of at least a preliminary course of treatment and education in the sanatorium. The selection of suitable cases for the sanatorium is not a matter which can be decided by rule, but must depend upon a careful study of the case. Each case should be considered individually and upon its own merits.

Climatic Considerations.—The selection of a suitable climate is a more difficult problem. It has been said that, "while no climate is specific, many climates are useful," and this is no doubt true. Here, again, the factors which must determine the selection are individual. It must be remembered that tuberculosis develops in all climates and re-

coveries are likewise made in all climates. Flick and others have contended that there is no value whatever in climate in the treatment of tuberculosis, but with such an opinion few can agree. On the other hand, the extravagant claims of some climatologists go to extremes in the other direction. Doubtless it is much more important to the welfare of the patient *how* he lives than *where* he lives, and modern experience has shown that, given the same care, supervision, and dietetic régime, a tuberculous invalid will do about as well in one locality as another. There are, however, certain indications for climatic treatment which present from time to time and which cannot wisely be ignored.

Many patients respond surprisingly to climatic *change*, seemingly regardless of the nature of the change, while others undoubtedly show more rapid improvement under certain climatic conditions. "The only way to determine the possibility of the beneficial action of a given climate is by giving it a trial" (8). However, there are certain principles on which it is well to base climate prescriptions, and which, if followed, cannot lead one far astray.

Copious expectoration, in the absence of extensive cavitation, is best treated in a dry atmosphere and at an altitude above 4,000 feet, unless the patient is past fifty years of age or there is present some contraindicating complication (arteriosclerosis, nephritis, uncompensated cardiac lesion, etc.). Early cases in the young and middle-aged do well in almost any climate, but are more favorably situated at an altitude above 1,000 feet and in a cold climate.

Elderly people do better, as a rule, at very moderate elevations and in a mild temperature. Laryngeal cases are more comfortable and probably more favorably situated in a mild, moderately moist atmosphere.

Patients whose disease is complicated by persistent albuminuria or nephritis do better in mild climates with little or no elevation.

It is generally believed that tuberculous children do better in marine climates, and in France most institutions for the treatment of these little sufferers are located on the coast. Forchheimer recommends long *sea voyages* for tuberculous invalids convalescing from intercurrent acute infections, such as influenza, or for relapse due to overwork, provided there are no serious complications.

Samuel Morton (19), writing in the early part of the nineteenth century, strongly advocated sea voyages which, as only sailing vessels were available, were long; and a sojourn in the West Indies, Madeira, or the Canaries, and cites many cases where such a course proved of great value.

Sea voyages have grown out of fashion in tuberculosis therapeutics of late years, probably chiefly because of the difficulty in commanding other conditions now known to be important factors in treatment. If it were possible, however, to give a tuberculous invalid other essentials to the "cure"—e. g., the proper medical supervision, suitable diet, etc.—while

at sea, it would seem reasonable to expect much benefit in certain cases from long voyages.

Climates may be grouped conveniently for present purposes into *high, dry climates*, such as the Rocky Mountain plateaux of New Mexico and Colorado; the region about Quito in Ecuador, and most of the great plateau of the Andes.

Low, dry climates, including the great desert of Arizona, Egypt, and portions of Southern California; *high, moderately moist climates*, such as may be found in the British Columbia Rockies; the high Swiss Alpine resorts, and certain sections of the Tyrol.

Climates combining moderate altitude, moderate dryness, with more or less wide temperature range between winter and summer, such as the Adirondacks, the Catskills, and the Asheville region in this country; parts of the Black Forest, and the Taunus Mountains in Germany, etc.

Low, moist, and moderately dry climates, including Florida; portions of Southern California on the coast, Georgia in the neighborhood of Augusta, and South Carolina about Aiken; the Riviera, both French and Italian, etc.

Marine climates, which vary in temperature and to some extent in other atmospheric conditions, are obtainable in long sea voyages. Such climatic treatment, with very favorable accessory conditions, was until a few years ago furnished invalids in an annual cruise from London to New Zealand and Australia and return by way of the Cape of Good Hope in a sailing vessel especially fitted out for the purpose. Results were said to be gratifying in pulmonary cases, but no reliable data are available.

Selection of a climate for the "incipient" or "moderately advanced" and uncomplicated case should be made on grounds of convenience to the patient. Such cases usually do better in a somewhat rigorous climate, irrespective of altitude, provided other elements in treatment are available. High altitude is not contraindicated with this class, but, on the other hand, it is not essential.

Elderly people, as a rule, do not react favorably to extreme cold or high altitudes, and should be sent to low, dry climates.

Complications, such as chronic nephritis, poorly compensated cardiac lesions, and severe laryngeal involvement, do better in low, moderately moist climates.

Joint affections, particularly in the young, are especially favorable for high, dry climates where there is little wind and a marked diathermancy, a point which has been demonstrated by Rollier in Leysin. See Figs. 4 and 5.

Advanced cases, with extensive or progressive cavitation, are more comfortable in low, dry, or moderately moist climates.

The advantages to be expected from a change of climate arise quite

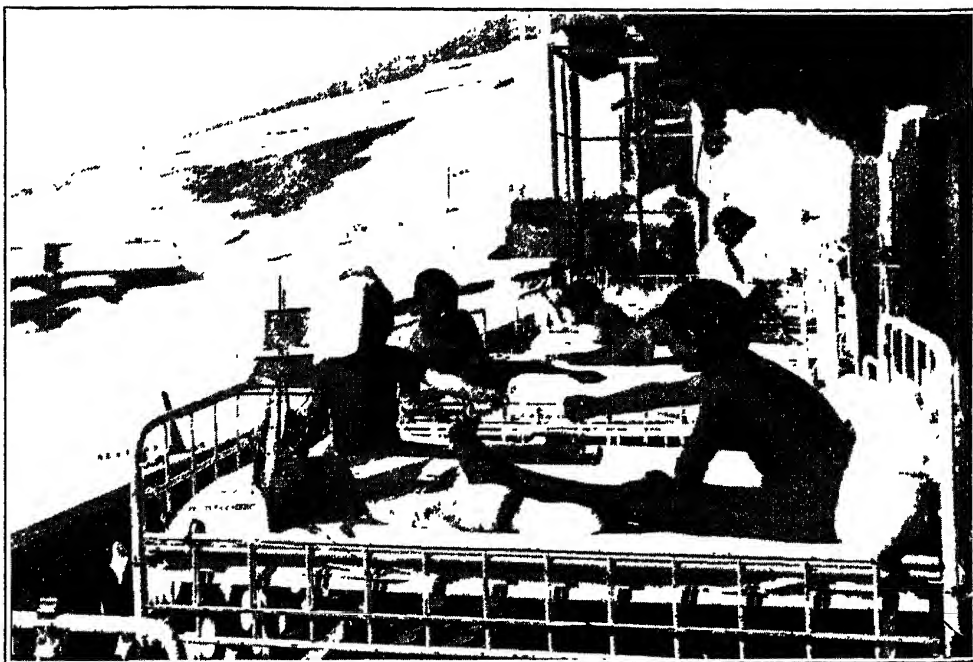


FIG. 4



FIG. 5

FIGS. 4 AND 5.—CLINIC OF DR. ROLLIER, LEYSIN (VAUD), SWITZERLAND. Bone and joint tuberculosis in children treated in the open air at high altitudes (5,000 to 7,000 feet). These patients, even in winter, were exposed naked in the open air, in the sunshine, without discomfort or untoward effects, and with remarkably beneficial results.

as much in all probability from the psychical as from the physiological effect. No doubt the change itself is an important factor. To-day, with the convenient means for rapid transportation, a few days suffice to remove a patient from the harsh winds, variable temperature, and cloudy skies of the New England coast to the dry, rarefied atmosphere and eternal sunshine of New Mexico, or the mild, equable temperatures of Southern California. The change is radical and the response is often quick and favorable, although, unfortunately, it is not always permanent. A century ago, when transportation facilities would not permit of such a journey, physicians were wont to send their patients from New York and Philadelphia into the pine country of New Jersey, with astonishingly good results—no doubt quite as spectacular as are attained nowadays by the longer journey and more radical change.

Morton (19), commenting on this phenomenon, attributed the improvement, in large measure, to the change itself. He recognized also the value of both extremes of heat and cold in the therapeutics of phthisis, and boldly prescribed the frozen winters of Mackinac or the warmth of the tropical islands, according to individual circumstances, and cites many excellent results in both instances. The three elements which determine the characteristics of a climate are: (a) temperature, (b) humidity, and (c) barometric pressure. An infinite variety of meteorological conditions is thus produced, regulated by altitude, distance from large bodies of water, latitude, and the influence of geographical surroundings. Many classifications of climate have been made by various climatologists—some very elaborate and complex, some entirely geographical, others physiological. Medical climatology finds the latter basis of classification most convenient, and for practical application to the needs of tuberculous invalids Sewall's suggestion is an excellent one: "According to this principle climate may be divided into two general groups, including (1) those which are sedative or relaxing, or even enervating; (2) those which are stimulating" (14).

After all, the chief feature in the treatment of tuberculosis is a life in the open air, and any climate which will favor such a life to the best advantage is a suitable one.

For the young and middle-aged, in the earlier stages of the disease, a stimulating climate by all means. For the old, feeble, "far advanced," or complicated case, if a change is to be recommended at all, it must be in favor of a sedative or "relaxing" climate. In any case, as pure an air as possible with a relatively large proportion of clear days and a reasonable amount of sunshine.

Climate still holds an important place in the therapeutics of tuberculosis, but it no longer occupies that preëminence which it formerly did. A change of air and scene is desirable in most cases, but, as has

been said by Brown (5), "Too frequent changes of climate—a wanderlust—may result disastrously."

Many unfortunate patients spend their time, money, and energy seeking from place to place what is really unattainable—a climate which will *cure* tuberculosis.

In the ordinary case it is a wise practice to select a climate which, in general characteristics, is similar to that in which the patient expects to live after his "cure," and it is always wise to give attention first to the available care and comfort which the patient will receive, and to make the climatic conditions secondary.

Sanatorium Treatment.—Hygienic-dietetic treatment, so called since Brehmer inaugurated the method at Goerbersdorf in 1859, consists essentially in placing the patient in the best possible environment for increasing resistance and counteracting the effects of toxins and waste by maintaining nutrition at its highest efficiency.

It is the rational method, which, as has been said, "treats the patient rather than his disease." It was worked out in the sanatorium and is, therefore, called the sanatorium method, but it is that which must form the fundamental principle of all treatment of tuberculosis, whether practiced in the institution, in the home, or in the open health resort, and whether it constitutes the sum total of treatment or is merely the basis for the elaboration of some special procedure. Briefly, it contemplates:

- (a) An almost constant life in the open air.
- (b) Rest and exercise apportioned to the individual and modified from time to time according to clinical indication.
- (c) A properly balanced diet suited to the individual requirements and also modified in accordance with changes in régime.

In the years which have elapsed since Brehmer's early experience little that is new or essentially important has been added to the excellent general scheme of treatment that he devised. There have arisen, however, two schools, so to speak, of sanatorium therapists, which differ in that one advocates rest, more or less complete, during practically the whole course of treatment, while the other stands for increasing exercise, graduated to the individual capacity, and, beginning as early as is consistent with clinical indications, persists, in the absence of contraindications, to the completion of the course. Both plans have their advantages, and it is difficult to determine which is of more universal application.

Brehmer himself advocated exercise as strenuous as the individual could carry out without obvious detriment. Detweiler, who was a pupil and former patient of Brehmer, on the other hand, was an advocate of rest, more or less continuous, throughout the whole course of treatment, and it is said that he was led to adopt his views because of harmful

effects upon patients which he had observed to follow exercise in certain cases.

On one point at present all are agreed—i. e., rest, during certain phases of the disease and under certain conditions which arise more or less frequently in the course of treatment, is absolutely essential to the best results and to avoid irreparable mischief. On the other hand, carefully graduated exercise under experienced supervision and in suitable cases is a most valuable auxiliary in the treatment. The subject of graduated exercise will be discussed in some detail presently. Here it is only necessary to say that in this matter of rest and exercise it is difficult to lay down hard and fast rules. Individual indications and contraindications have to be measured and many factors considered before an intelligent plan of procedure can be prescribed.

Diet is another feature of the rational method upon which there have been from time to time much discussion and some difference of opinion. *Hyperalimentation* seemed to be an obvious indication in a disease which, like tuberculosis, is characterized by every evidence of innutrition and excessive waste; and an overabundant diet with a large protein constituent was a feature of treatment with almost all therapists until recently.

This *forced diet*, indiscriminately applied, was, in the course of time, found to be harmful. The immediate effects were gratifying and sometimes spectacular in the matter of weight gains, but, sooner or later, if persisted in, it produced digestive disturbances of more or less permanent and serious character and was not infrequently followed by nephritis and other complications. The protest which naturally was raised against forced feeding as soon as its dangers became apparent has brought about a salutary modification in this practice, and a more rational and scientific diet is the rule at present. Although a generous, wholesome, and, at the same time, a properly balanced ration is still recognized as one of the most important factors in treatment, a few still advocate a high protein constituent, but the excesses of a few years ago in this regard are now rarely observed.

The subject of diet in tuberculosis is of sufficient importance to justify special consideration and will be discussed by itself presently.

The impression has become popular that, since the armamentarium of the therapist in this disease is comprised almost exclusively of the three elementary factors—open air, wholesome diet, and properly balanced rest and exercise—therefore, the process is so simple that it may be carried out by any one, physician or layman, of ordinary intelligence with equal chance of success. This is an egregious fallacy which has too often led to disaster. The process is by no means simple. It requires an almost daily readjustment to the individual by one thoroughly schooled in the method.

The part played by diet in tuberculosis is of great importance, and to effect the best results necessitates an unusual familiarity with the whole science of nutrition, and a careful study of individual peculiarities of metabolism. Again the crux of success in the treatment of phthisis lies in the proper adjustment of rest and exercise. This is a matter which, as will be shown presently, cannot be laid down by any rule of thumb. Open air and diet do not of themselves cure tuberculosis, and the sooner this fact is understood the sooner shall we be able to avoid some of the disappointments and failures which are so painfully frequent now.

Tuberculosis, it must be remembered, is the result of a bacterial infection, and can no more be successfully treated by the patient himself or the tyro in medicine than can typhoid fever or diphtheria. That some individuals do and will continue to recover in spite of self-treatment or with no treatment at all is no argument to the contrary. Because a serious gunshot wound occasionally results in recovery without the aid of skilled surgery is no sufficient argument for abolishing the army medical corps.

Management of the Individual During Stage of the Active Process.—Fever is one of the most constant and characteristic symptoms of tuberculosis, and is almost invariably an evidence of an active process, of “auto-inoculation” with the products of the disease. At this stage, therefore, the patient should be kept in bed and as quiet as possible. If there is a rule of practice in the therapeutics of tuberculosis, which is generally applicable, this is one. Rest in the open air in bed, with the same restrictions, except as to diet, that would be exercised in a case of typhoid fever, is the most effectual and surest way which is available in the present state of our knowledge to bring the temperature to normal and to prevent destructive changes in the lung.

The initial onset of tuberculosis and every subsequent extension of the disease are probably always characterized by fever, which may be transitory and often overlooked, or persistent over a long period, and constitutes the most conspicuous, and, in some instances, the only subjective, evidence of the lesion. In any case, it is an indication for rest, which will be effective in proportion as it approaches the absolute.

During this period the patient should not be allowed to bathe himself, to receive visitors, write letters, or read. Meals should be served to him in bed trays, and he should be allowed to get out of bed only for the purpose of using a commode (not to go to a water closet), or to sit in a reclining chair while his bed is being changed. Paterson even advocates the use of a bedpan and feeding by an attendant, but such extreme measures are seldom necessary. Provided this treatment is promptly and rigidly enforced during the initial fever, or in the case of subsequent exacerbations in the earlier stages of the disease, it usually suffices, without other measures, to bring the temperature to normal and arrest the activity of the process in a comparatively short time. If a protected

sleeping porch is available the patient should be kept out of doors, and where the door is sufficiently wide to permit it the bed wheeled in and out, as occasion demands. When this is impracticable two beds are desirable—one within and the other without the connecting door or window, so that the patient may be brought in and out with the least possible exertion on his part.

In the winter in a cold climate caution must be exercised to avoid undue exposure in such transfers; although the danger of “catching cold”



FIG. 6.—DR. S. A. KNOPF'S WINDOW TENT.

is less than might be imagined. In going from a bed in a warmed room to one which has been exposed to the cold it is safest to warm the outside bed with a warming pan or hot water bottle before the transfer is made.

When an outside sleeping porch is not available an excellent device in the form of the window tent originated by Knopf has been found practicable (see Figs. 6 and 7). By this arrangement the patient has the benefit of outdoor air with little exposure and without subjecting others in the apartment to cold or drafts.

During this period of more or less acute activity there is usually a loss of appetite—digestive disturbances, constipation, and a sense of “be-

ing sick," best described by the term "malaise." A symptom-complex in short not unlike the manifestations of any other bacterial invasion. Once the diagnosis is made, frequent physical examinations are distinctly inadvisable. The effort of coughing and of changing position and the ex-

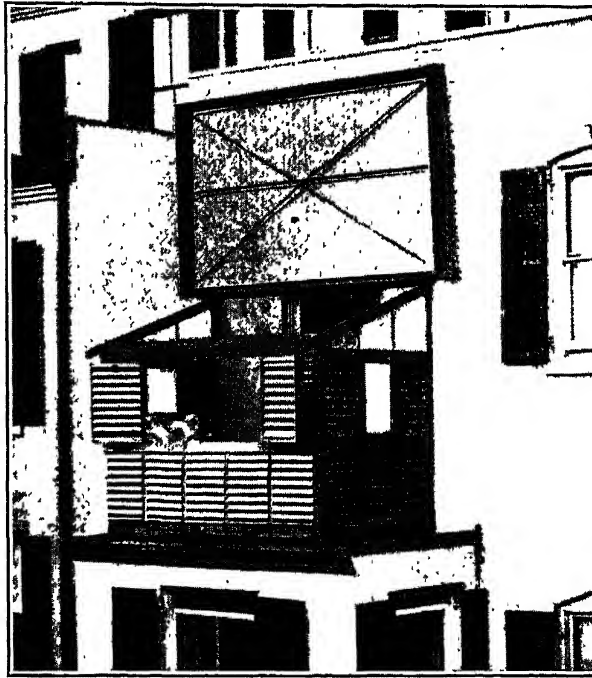


FIG. 7.—DR. S. A. KNOFF'S "STAR NOOK," AN OUTSIDE SLEEPING CAGE PROTECTED FROM VIEW BY FIXED LOUVERS, ADAPTED TO CITY CONDITIONS.

citement incident to the examination almost inevitably produce "autoinoculations" and worry on the part of the patient, and are to be avoided as far as possible.

Diet should be simple and preferably in liquid or semiliquid form, especially during the higher range of fever, but if, as sometimes happens, the patient exhibits a desire for food, there is no objection to a generous mixed diet sufficient to satisfy the appetite. When anorexia is present food of the most easily digested character (preferably milk and raw eggs) should be given at short intervals, but under ordinary circumstances this will not be found necessary, and it is better to maintain the usual interval between meals to which the patient is accustomed in health (cf. section on diet).

Mild purgation is desirable at the start and at intervals of one, two, or three weeks, as indicated. If at first the patient's appetite is fair and subsequently fails after a week or more of generous nourishing, a fast of a day or two is often sufficient to restore the balance without other recourse, and has been found an excellent and unobjectionable practice. During this phase cough and night sweats are usually the most trouble-

some symptoms. The latter should be controlled, if possible (cf. medical treatment of symptoms), and is most readily accomplished by absolute rest in bed in the open air, with as light a covering as will suffice for comfort. Sponging with alcohol and prompt change of clothing should follow the sweat. Patients are more comfortable between sheets of soft flannel or outing flannel even in the warm weather.

It is important that unnecessary cough be controlled at all stages of the disease, but in the presence of symptoms of activity a persistent cough will defeat all effort to bring the temperature to normal, and will produce disastrous "autoinoculations" in spite of every other precaution which may be taken. It is, therefore, essential that cough be controlled during this period. If simple measures fail, e. g., inhalations, counterirritation, etc., opium in some form is indicated—codein, heroin, or morphin, in doses sufficient to secure the desired results. Objection has been made by some to the use of an opiate for the control of cough, but, in the presence of fever and other constitutional manifestations of active tuberculosis, it is absolutely necessary to secure as perfect rest as possible if we are to prevent excessive and disastrous absorption of bacterial products. A persistent cough involves an exertion equivalent in proportion to playing tennis (a fact seldom realized), and any ill resulting from the use of opium to control it is far more than neutralized by the unquestionable benefits resulting from a cessation of the cough. Upon the nurse in charge of the patient depends, in great measure, the success of the treatment. It is often a difficult matter to impress upon the mind of the average hospital nurse, untrained in the special care of phthisical patients, the importance of absolute rest and what that term implies. At first sight it seems such an unnecessary extreme to enforce so complete inactivity upon a patient who often neither looks nor feels very sick. It frequently happens that a nurse who would not think of permitting the slightest indiscretion in a typhoid or pneumonia case will, through carelessness or ignorance of the principle involved, fail to insist upon the necessary immobilization during the active phase of tuberculosis, with the result that quiescence is long postponed and irreparable mischief is permitted to occur. It goes without saying, therefore, that a thoroughly competent nurse who has the intelligence to appreciate the value of strict obedience, and the tact to enforce it upon the patient with the least possible friction, is the *sine qua non* in the successful treatment of this phase of the disease.

The necessity for keeping the patient quiet during the feverish period of his disease has been long recognized, but the importance of as complete immobilization as it is possible to carry out has only recently been emphasized. The credit of introducing this particular feature into the therapeutics of tuberculosis is largely due to Paterson of Frimley Sanatorium in England.

By the older method of *comparative* rest the patient was sent to bed, but permitted to get up to bathe, sit up to eat his meals, allowed to cough unless he himself complained, and usually permitted to walk some distance, often up or down stairs, to the toilet, read, write letters, or receive visitors. The result was often many weeks or months of fever, extension of the lesion in the lung, and a marked general exhaustion of physical forces. By the newer method the active stage of the disease, if it is the initial onset, is frequently limited to from one to three weeks, and in the case of recrudescence to a few days, with none of the untoward and often disastrous results upon the general health which were formerly observed. The two methods are excellently illustrated in the two temperature charts subjoined, which are taken, the one from the case history of a patient treated some eight years ago before the importance of absolute rest was fully understood, and the other from a recent case treated under the newer plan.

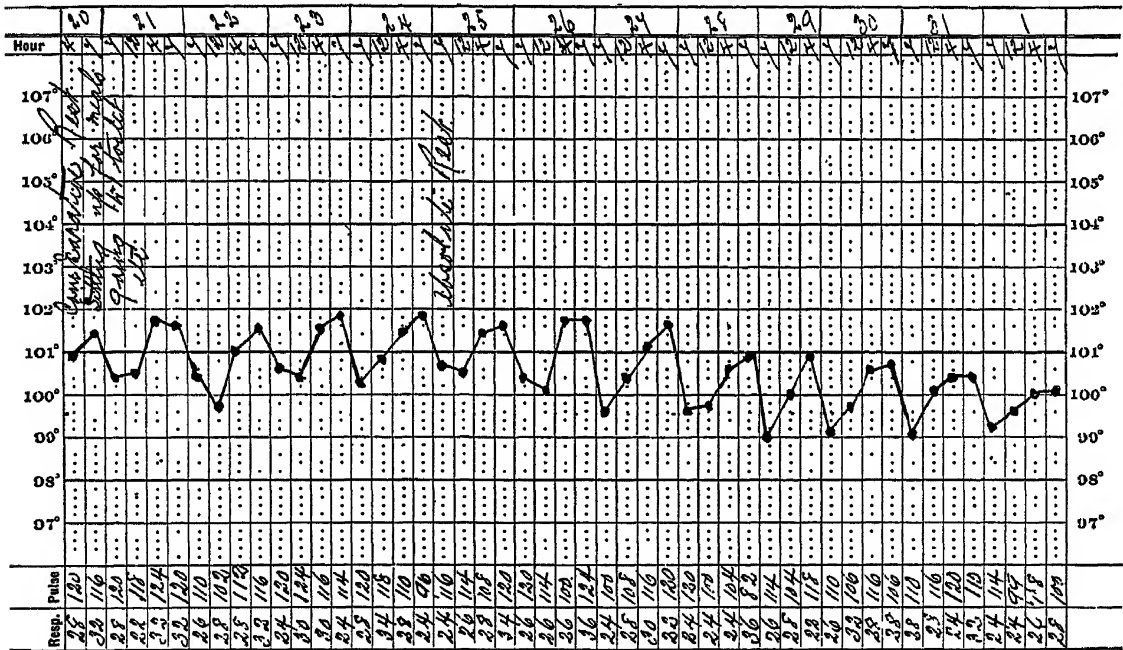


FIG. 8.—TEMPERATURE CHART, SHOWING UNSATISFACTORY RESULT FROM "COMPARATIVE" REST WITH CONTINUOUS EXCESSIVE AUTOINOCULATIONS, FOLLOWED BY PERIOD OF "ABSOLUTE REST," AND BETTER CONTROL OF AUTOINOCULATION.

Temperature, while not the only practical criterion, is the most readily available means of determining the activity of a tuberculous process, and taken in connection with pulse rate, amount and character of the sputum, and such subjective symptoms as headache and malaise is a safe clinical guide. It is important, therefore, that the nurse or physician should be familiar with the peculiarities of the temperature curve in health and disease, and particularly in tuberculosis, in order to advise intelligently in these cases.

Body temperature varies somewhat in different individuals of the same sex, and in the two sexes—e. g., normal temperature in an adult male registers, by mouth, from 96.8° to 98° F. in early morning and from 98.6° to 99° F. in the evening; by rectum from 98° to 99° F. in

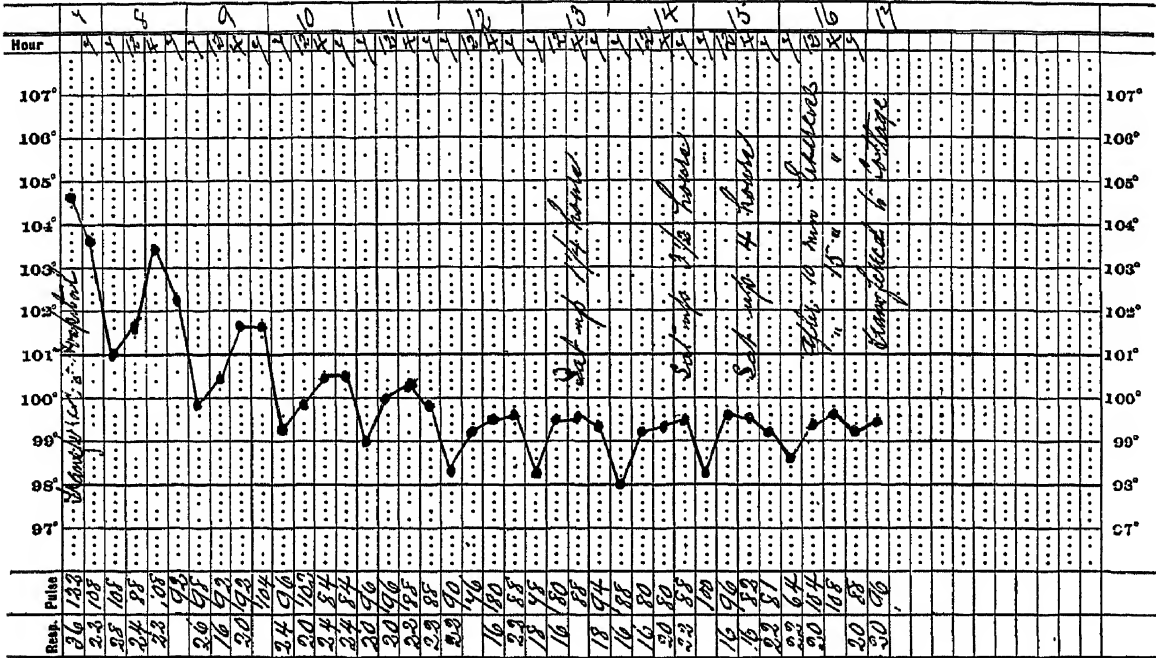


FIG. 9.—TEMPERATURE CHART, SHOWING MODERN METHOD OF CONTROLLING AUTOINOCULATION BY ABSOLUTE REST. Temperature falling to normal on sixth day.

the morning, and from 99.6° to 100° F. in the evening, under conditions of rest. For an adult woman the respective range is a fraction of a degree higher. In children body temperature is much more easily influenced by various physiological processes—a fact which must be taken into consideration when treating tuberculous children. A range of temperature exceeding two degrees during the day, therefore, in an adult at rest must be regarded as abnormal, and in the presence of other familiar symptoms may be taken as an indication of activity in a tuberculous focus and consequently for treatment in bed.

Mouth temperature is considered by many as sufficiently accurate for practical purposes, although under conditions of exercise in cold weather it is often misleading. Rectal temperature, on the other hand, is not subject to influence by atmospheric conditions, and, while undoubtedly more troublesome, is much more reliable, and consequently a safer guide. In this article, unless otherwise specified, body temperatures are always referable to rectal observations.

When the patient with an active lesion, either initial or recrudescing, has been kept on "absolute rest" until his temperature does not reach 99° F. in the morning or 100° F. in the evening for several days (three

to ten days, according to circumstances), he may be allowed to sit up for a half hour, go to the toilet, but not to bathe himself, and sit up in bed to eat his meals. If this is found not to adversely influence his temperature, his period of sitting up may be extended gradually until he is out of bed in a suitable reclining chair all or most of the day. Many patients find it tiresome and uncomfortable to remain in a reclining chair for more than two or three hours at a time, and there can be no objection in such cases to varying the position occasionally by changing to a Morris or rocking chair.

Many "cure chairs" have been devised for this purpose—most of them possessing some points of advantage. Whatever form is chosen should be so constructed as to permit of slight flexion of the leg on the thigh and have an adjustable back. It should have an upholstered removable cushion, preferably in two pieces, and be long enough to include the patient's feet when lying outstretched.

The patient may now be permitted to bathe himself and should be encouraged to take a cool sponge or shower bath every morning. If he has reached this stage without indication of recurring activity, as shown by temperature curve, etc., exercise tests may be begun: at first a ten or fifteen minutes' walk on a level path not to exceed two hundred yards. Prior to this the patient's temperature has been taken at intervals of four hours four times daily. Now it is advisable to take the temperature immediately after the exercise and again after half an hour's rest, lying down either on the bed or on the reclining chair. Usually it is practicable to prescribe the exercise for both morning and afternoon. The walk may now be extended by a certain distance or by its equivalent in time, five minutes daily, until the patient reaches from thirty to forty-five minutes morning and afternoon. In most cases, with favorable prognosis and when proper caution has been exercised, the temperature will be found to show little variation up to a half hour's exercise, but beyond this it is common to note what has been happily termed "oxidation temperature"—i. e., a curve distinctly influenced by exercise. When the period of confinement has been a long one "oxidation temperature" is apt to occur on much lighter exercise than is the case where the acute phase has been quickly brought under control. This rise in temperature is, of course, physiological, and can be demonstrated in any perfectly normal individual, however robust and athletic, under the influence of exercise of sufficient amount or violence. Its characteristic is its ready fall to normal under rest in from twenty to thirty minutes. In the case of the patient under consideration the rise will be slight at first, perhaps to 100° F. after the half hour's walk, subsiding to 99.6° F. with the half hour's rest. With a walk of forty-five or sixty minutes, at an ordinary gait, it is not uncommon to observe a temperature of 100.6° to

101° F. immediately afterward, which should, however, subside to normal with the rest following.

It is well to take an evening record occasionally, although, if appetite does not flag and the sputum is not increased in amount or other contra-indicating symptoms do not appear, one may feel very secure that nothing but benefit is resulting from the exercise. By the time the patient has reached ninety minutes twice a day he has usually acquired a "temperature immunity" to the smaller "doses," and a walk which would formerly have occasioned a rise of a degree will now be found to have little or no influence on the temperature. But any change in the form of exercise, bringing into use sets of muscles previously unemployed, will very likely produce a disproportionate "oxidation temperature."

While the temperature curve is the chief guide as to the activity of a tuberculous lesion, there are other symptoms, of course, which even in the absence of fever demand consideration as evidence of unsatisfactory progress and an indication for a return to comparative or absolute rest, such, for instance, as increased cough or expectoration, an unfavorable change in the character of the sputum, hemoptysis, pleurisy, an increase in pulse rate persisting after the half hour's rest, loss of appetite, dyspnea, and cyanosis. Most of these symptoms are not very apt to occur without attendant rise in temperature, but may do so, and therefore merit attention. Again a sudden rise in temperature may not invariably indicate renewed activity in the lesion, although until other cause is discovered it is safest to so regard it.

Assuming that the case is uncomplicated and that progress is favorable, the patient should from the start show a gain in weight, more or less rapid, in proportion to the previous loss, and this without recourse to a "stuffing" process. Three meals daily with those accustomed to American dietetic habits usually suffice, but, where the previous loss has been considerable, these may be supplemented by intermediate diets of milk, broth, raw eggs, etc. (cf. diet), provided the patient can take the additional nourishment without interfering with his appetite for the regular meals.

It is highly desirable to lay out a daily régime adapted to the individual, but following, in a general way, a regular routine. This is a simple matter, easy of accomplishment in the sanatorium, where all are engaged in the one pursuit of "taking the cure," but more difficult for the patient to follow out in the home or the open resort. With such patients it is almost essential to have a written or printed program. Something like the following should form the basis for such a routine, modified to suit special requirements:

Daily Routine

A. M.

7:00	Patient comes indoors, or, if sleeping inside, windows closed and heat turned on.
7:30	Rise, bathe, and dress.
8:00 to 8:30	Breakfast.
9:00 to 10:00	Rest in chair.
10:00 to 12:00	Exercise as prescribed.

P. M.

12:00 to 1:00	Rest in chair or on bed.
1:00	Mid-day dinner.
Until 3:00	Rest.
3:00 to 5:00	Exercise as prescribed.
5:00 to 6:00	Rest.
6:00	Dinner or supper.
7:30 to 9:00	Recreation.
9:30	Go to bed.

This program involves at least twenty hours each day in the open air, provided the patient sleeps out of doors. During the period that the patient is on more restricted exercise the balance of the four hours should, of course, be spent in the rest chair, and in the final stages of the "cure," when more than the four hours are taken up by work or exercise, the latter should begin earlier so that it may be finished not later than twelve o'clock in the forenoon and five o'clock in the afternoon. It is seldom that exercise will interfere with intermediate diets, as by the time the patient has reached an hour's exercise twice daily he no longer requires the extra diet.

It is advisable to precede and follow the mid-day and evening meals by at least half an hour's rest, lying down, without talking or reading.

The recreation period in the evening may be spent indoors if ventilation is good—reading, writing, playing games, or indulging in any innocent social diversion—provided always that excitement be not sufficient to disturb the temperature or produce other unfavorable symptoms. In an institution where both sexes are treated there can be little danger from intermingling if a strict supervision is observed. Dancing should, of course, be prohibited for obvious reasons. Despite the objections which have been raised by some, little real harm and some good may come from these evening gatherings. This daily social hour is looked forward to by patients as a relaxation and stimulation, and helps in no small measure to ease the burden of monotony. In institutions where it is permitted under proper espionage it has seldom, if ever, been found an objectionable practice.

Some institutions, both in this country and abroad, while permitting

intermingling of the sexes during periods of recreation in the common room, or within strictly defined limits of the grounds where close supervision is possible, rule against it at other places and times, especially during exercise. Such restriction is undoubtedly desirable, since exercise forms such an important part of the treatment and at best is difficult of measurement. Any circumstance which is likely to modify its effects or introduce other unknown elements is to be avoided.

In sanatoria where both sexes are treated, therefore, rules governing the relations of the sexes must be clearly stated and rigidly enforced if the best results are to be expected. The most frequent age period of the disease, the character of the treatment, and the opportunities for transgression incident to lax discipline combine to throw temptation in the way of patients, from which they must be protected.

It is no less necessary in practice outside the institution to make clear to the patient the dangers of emotional excitement, and to insist upon careful restriction as regards the relations of the sexes.

Amusements.—The list of amusements and diversions to which patients in various stages of the "cure" are eligible is a long one, limited, of course, by individual conditions. Many games, such as croquet, clock golf, quoits, target practice, etc., may be utilized as therapeutic exercise, and can be approximately measured. The most generally applicable combined form of amusement and exercise, and that which is most easily and accurately measurable, is walking. The environment of most health resorts and sanatoria, moreover, affords a variety of walks more or less picturesque and interesting. With suitably placed rest stations such walks form the staple means of combining entertainment and exercise. Clock golf and croquet are quite suitable for patients able to walk a mile or more without temperature disturbance. A miniature golf course, excluding the long drives, affords a very attractive form of exercise. Golf as ordinarily played, together with riding, shooting, stream fishing, mountain climbing, tennis, baseball, and cricket, are suitable only when convalescence has been firmly established and thoroughly tested by less strenuous and more easily measurable exercise or labor. A patient does wisely, in fact, to avoid such violent exercise as tennis and baseball for at least a year after returning to ordinary habits of life, and even then to undertake them with the utmost caution. Of the amusements which involve little or no muscular exercise there are the various games of skill and chance which may be allowed in moderation. Some individuals, however, are unable to participate in entertainment of this sort without a degree of excitement which is harmful. Chess, for instance, will often produce a dangerous rise in temperature in one who plays intensely and with studied skill. The same is true in games of chance where even an insignificant winning is at stake. In institutional practice gambling of every sort should be unequivocally prohibited, and discretion exercised in permitting

contests of whatsoever nature because of the uncertainty of the results of the excitement upon the individual.

It is this uncertainty, indeed, which makes the choice of regular entertainment in the institution something of a problem. However, a conscientious patient who goes through the day's routine properly finds comparatively little time for indulgence in amusements which are at all likely to prove harmful. A rubber of whist, a game of chess, dominoes, drafts, or patience during the recreation hour in the evening will, in the majority of cases, do no harm.

The opportunities for studying bird life and the flora of the locality form a never-ending source of entertainment and profit in many resorts, and should be encouraged quite as much for the mental stimulation as for the healthful character of the exercise involved. Forestry and geology may also be included in the list of subjects to which the serious-minded patient may, with advantage, devote considerable time without the risk of overexertion.

In the open resort, where rules of conduct cannot be made so easily and cannot be enforced at all, it is necessary to take up such matters much more carefully and fully with the patient in order that he may see the matter in its proper light and from choice avoid the possible dangers.

Gambling, late hours, and the incidental dissipation are common in all health resorts among a certain class of invalids and semi-invalids, and this fact should be borne in mind in advising the young man of inexperience about to enter upon a course of treatment away from home influences. He must be made to understand that he may very easily undo in the evening all the advantage which he can possibly gain by strict adherence to the "cure" during the day, by what he might otherwise consider innocent diversion.

Clothing.—There is usually a tendency on the part of patients and their families to overdress rather than the contrary. As a general rule, the patient should be instructed to dress for the season and for comfort. In cool weather it is advisable for the patient to wear woolen underclothing, provided it is borne without discomfort. To some the feeling of wool next the skin is extremely disagreeable, however, and under such circumstances it need not be insisted upon. Linen mesh or a ventilated cotton fabric is a good substitute in such cases if the patient is comfortably warm in such underdress.

In the cold winter season in the northern resorts, however, it is safer to employ woolen garments, even if a light cotton garment has to be worn underneath. The patient will thus be made warmer and more comfortable with lighter clothing than is possible otherwise. The outer clothing should be of loose soft material and, in the case of women, easily adjustable. The Norfolk jacket and knickerbockers with heavy stockings

and boots in the cooler months, and flannels in the summer months, make suitable dress for men.

Women should be advised to wear an easy-fitting dress, short skirts; and, if corsets must be worn at all, they should be very loose and so adjusted as to give the greatest possible freedom of motion to the body and offer no impediment to respiration.

In advising as to dress it should be remembered that, for the greatest comfort, either in exercise or rest, a loosely-fitting garment is eminently preferable.

The tuberculous patient should wear heavier clothing in cool weather than should the ordinary person in health, simply because a greater portion of his time is spent in the open air exposed to the weather. There is no good reason, however, why the disease *per se* should demand a heavier dress.

For outdoor sleeping warm, soft fabric should be worn, and pajamas are preferable for both sexes. It is not desirable to wear underclothing at night, even in the coldest weather, and comfort is secured by woolen bed socks and, under extreme weather conditions, by a loose sweater and suitable sleeping helmet.

Care of the Teeth.—In a disease the treatment of which depends to so large an extent upon a healthy condition of nutrition, every error in the alimentary tract which can possibly be corrected should receive careful attention and appropriate treatment. This is such an obvious indication that it is the more remarkable to find such neglect of the condition of the mouth as it is the rule to observe. Among institutions intended to reach the poorer classes it is indeed the exception to find a healthy condition of the mouth among patients upon admission, and even among the well-to-do serious dental caries, pyorrhea alveolaris, and chronic alveolar abscess are frequent as the result of neglect, while the minor oral disturbances, such as neglected calcareous deposits and small dental cavities between the teeth, are found upon examination in fully one-half the patients admitted to the sanatorium.

There can be no question that such conditions are inhibitory to the best results of treatment, and they should in all cases be corrected at the earliest possible moment. A few sanatoria, especially in England, insist upon the correction of oral defects prior to admission.

A competent dentist should be attached to the staff of every sanatorium, and a rigid examination of the teeth and mouth should be made upon admission, and at suitable intervals during residence. In the treatment of a patient at home or in the resort the same scrupulous care should be exercised as to this point.

Laryngeal Complications.—In the course of chronic pulmonary tuberculosis the larynx becomes involved to a more or less serious extent in a large proportion of cases. Of the last 915 cases admitted to Loomis

Sanatorium prior to November 1, 1910, ninety-eight, or 10.7 per cent., presented a more or less severe tuberculous laryngitis, while in addition ten, or 1.09 per cent., had *true* laryngeal tuberculosis. Fortunately, in the majority of these cases the complication is not a grave one, and yields readily to voice rest and appropriate treatment.

For the purpose of this article tuberculous lesions of the larynx may be conveniently grouped into three classes:

(a) A more or less severe catarrh of the larynx characterized by congestion and swelling of the membrane; some discoloration of the vocal bands, with or without small superficial ulceration either in the interarytenoid fold or along the free edges of the posterior halves of the vocal bands. The voice is usually affected in this form of laryngitis, but there is rarely pain or other subjective manifestation.

(b) Infiltration of one or both sides of the larynx, with deeper and more destructive ulcerations, often very extensive and producing more or less deformity—in favorable cases showing a tendency to cicatrization with consequent permanent narrowing of the glottis, sometimes producing a dangerous degree of stenosis. Partial or complete aphonia is the rule in this form, and the lesion may be extremely painful, particularly if the epiglottis or the glossoepiglottic folds become infiltrated or ulcerated.

(c) A true laryngeal tuberculosis in which the localization first appears as a rather deep-seated tumor apparently originating in the perichondrium or the deeper tissues of the soft parts of the larynx. The overlying mucous membrane is pale and “watery” in appearance, and there is commonly considerable edema of the adjacent cellular tissue. In this form of disease there is rarely at first any ulceration; the voice may or may not be affected, and, while pain is the rule, it is astonishing to what an extent this extremely grave form of laryngeal tuberculosis may progress without any noticeable symptom becoming manifest, the patient sometimes becoming aware of the disease only by the appearance of external swelling over the site of the tumor. This form is almost invariably progressive, and after breaking down produces the most distressing symptoms.

The first principle of treatment in any form of tuberculous laryngitis is *rest*. The patient should be isolated, if possible, as otherwise it will be difficult to refrain absolutely from the use of the voice. In the milder types of group (a) the patient may be permitted to whisper, but not to speak; in all other types even whispering should be forbidden. If there is much cough the patient is better off in bed and opium should be employed unsparingly to control cough. It is remarkable how promptly the less serious tuberculous complications of the larynx yield to treatment by rest alone, or with some opium preparation added to control severe coughing; superficial ulcers heal readily, congestion and swelling subside, and often a few days suffice to restore such a larynx to normal.

In the more severe forms of group (a) and in most cases falling under groups (b) and (c), it will be necessary to employ supplementary local treatment—inhalation of steam vapor, simple or medicated, is usually grateful, allaying irritation and cough, and in many cases is undoubtedly of value in the healing process. For this purpose there are numerous devices obtainable, among the most practical of which is the simple stoneware jug known as "Maw's Improved Inhaler." This inhaler is filled to the line indicated on the outside with steaming hot water, and the rising steam inhaled through the mouth tube. To the hot water may be added some soothing preparation possessing antiseptic and healing properties (*vide infra* Symptomatic Treatment).

The value of direct medicated sprays, topical applications, or intralaryngeal or tracheal injections depends upon the individual toleration on the part of the patient, and upon the technical skill of the physician in the somewhat delicate operation of treating the larynx. To insist upon topical treatment of a diseased larynx in a patient who does not tolerate laryngeal manipulation without spasm or uncontrollable resistance is not only useless, but is almost certain to do harm and make a bad matter worse. On the other hand, the physician unskilled in laryngeal technique is very apt to do more harm than good in attempting to treat this condition locally.

The tuberculous larynx, if given absolute rest from the use of the voice, and if the cough is controlled, is prone to heal without other measures, and injudicious interference in the form of topical applications at the hands of inexperienced operators, or in a patient who cannot easily be educated to a control of the laryngeal muscles, is decidedly to be avoided. In the past there has been altogether too much meddling with the larynx in tuberculosis. Given complete rest of the larynx by absolute silence and control of the cough, nine out of ten cases coming under group (a) and probably a majority of group (b) will heal without other measures.

However, in the hands of an expert in the manipulation of the larynx, and with such patients as can be readily trained to a tolerance of the treatment, there is undoubted benefit in the use of suitable sprays, medicated injections, and direct applications in groups (a) and (b). Nothing is gained by local treatment in group (c) except the temporary relief of pain by the application of some local anesthetic from time to time as required, and in this forelorn class an extremely bad matter may be made worse by injudicious and inexperienced attempts at local treatment.

The remedies which may be used in the local treatment of laryngeal involvements are many. Every laryngologist has a preference for his own methods and the solutions to which he has become accustomed. The principle of procedure, however, is nearly always the same.

The larynx and adjacent parts are first partially anesthetized by a weak solution of cocain or eucain; the diseased mucous membranes are

then thoroughly cleansed by means of some mild alkaline wash, and, finally, the points of ulceration stimulated by a direct application of a suitable preparation. It is in the choice of this stimulating or cauterizing preparation that most difference of opinion obtains. Some laryngologists prefer to curette the surface of the ulcer and subsequently apply stronger or milder solutions of lactic acid, formol, and even employ the galvanic cautery, according to circumstances. Such radical procedures do not, however, appear justifiable, and, as they must in any case be left to specialists if employed at all, they need not here be described. For cleansing purposes there is nothing better than a dilute Dobell solution, or the following alkaline antiseptic which is obtainable in tablet form for making fresh solutions as required:

		Gm.
R	Sodium bicarbonate	5 grs. 0.300
	Sodium borate	5 grs. 0.300
	Sodium chlorid	5 grs. 0.300
	Sodium benzoate	7/24 gr. 0.021
	Oil gaultheria	7/480 min. 0.001
	Sodium salicylate	7/24 gr. 0.021
	Oil eucalyptus	7/240 min. 0.002
	Thymol	7/240 gr. 0.002
	Menthol	7/480 gr. 0.001

Dissolve one tablet in two to four ounces of warm water.

Or a simple normal saline solution will suffice. When the pharynx and larynx have been thoroughly cleansed of all accumulated mucous and mucopurulent secretions, if there are no ulcerations, the treatment may be terminated by the inhalation for a minute or two of a finely divided spray of something like the following solution:

		Gm.
R	Menthol	20 grs. 1.30
	Creosote	20 mins. 1.30
	Eucalyptus oil (Tyndale's)	4 dr. 16.00
	Albolene q. s.	2 ozs. 64.00

If there are ulcerations and they can be reached by direct application, excellent preparations for the purpose are: a six per cent. solution of iodine in 8 per cent. alcohol in oil of petrolatum; a saturated solution of iodoform in ether; a weak lactic acid solution, or formalin.

Should the points of ulceration extend into the trachea, and beyond the reach of the applicator, resort may be had to intralaryngeal or intra-tracheal injections, which have often proved most beneficial in these cases. The following solution has been thus employed advantageously:

Lake Mixture (Richard Lake)

R	Naphthalin	3.0 gm.	gr. xlv
	Oil cinnamon	0.5 gm.	gr. viiss
	Oil petrolatum	96.5 gm.	℥iii

An intralaryngeal or intratracheal injection of this solution should be made every day or at least every second day. Fifteen to thirty drops are sufficient for a single injection. This solution can be used to advantage in connection with applications of the six per cent. iodine solution in oil, and, when so employed, they should be used on alternate days. It is always advisable to precede the application or injection by a thorough cleansing, as above described, and partial local anesthesia renders the process much easier both for the operator and the patient.

Local treatment of a tuberculous larynx should in any case be considered as a supplementary measure to the more important procedure of placing the larynx in a state of as complete rest as possible. If the patient cannot receive treatment, therefore, without a considerable journey to and from the physician's office, with the incidental exertion and the almost unavoidable use of the voice, it is much better that he remain at home and in bed, and in the majority of cases he will thus secure a much better chance of recovery.

When ulceration has been extensive and there is a resultant stenosis from cicatrization, it is sometimes necessary to resort to measures for the relief of the stenosis, which has at times become so extreme as to cause death from asphyxia. Tracheotomy is to be adopted only as a last resort in tuberculous disease of the larynx, and, except to relieve impending suffocation, should not be considered as a suitable operation in these cases. On the other hand, intubation is especially applicable and gives instant relief. Special tubes have to be made, as a rule, as the ordinary sets do not contain tubes suitable for the adult throat.

SYMPTOMATIC TREATMENT

As we have already seen, it can hardly be sufficiently emphasized that the main reliance in the treatment of tuberculosis must be placed on hygienic measures. As a general rule, when the patient is treated with fresh air, a wholesome diet, and properly regulated rest and exercise, all symptoms will soon be greatly ameliorated or disappear entirely. In such cases no especial treatment of symptoms is necessary, and patients do better without any such. In other cases, however, it may be found that one or more of the symptoms or complications of the disease is particularly exaggerated or unusually persistent, or even of the nature of a distressing emergency likely to endanger the life of the patient. In

these cases especial measures directed toward the relief of such symptoms may be called for. The commoner symptoms and complications with the appropriate treatment for each will, therefore, be considered in the following pages.

Cough.—Cough is due to a reflex nervous stimulation, arising, in the great majority of instances, from somewhere in the respiratory tract. It is important to determine, as an aid to treatment, the location from which the reflex arises. While a "stomach cough," due to stimulation of the vagus endings in the stomach, is spoken of by many authors and is theoretically a possibility, it hardly deserves serious consideration, and is mentioned here only because it is far too frequently used by physicians as a convenient shield behind which may be found shelter from the necessity of telling an unwelcome truth to patients. Abnormal conditions in the ear, such as impacted cerumen, or in the nares, such as spurs or polypi, may rarely cause cough. An elongated uvula is another occasional cause. All such conditions should, if possible, be corrected. Much more common are the pharyngeal causes, a chronic pharyngitis often producing a persistent, irritating cough. This when found should be treated, preferably by alkaline sprays and by applications of silver nitrate solution (2 to 10 per cent.), or iodine solutions. Laryngitis, also, either simple or tuberculous, is a common cause of cough which can often be lessened by appropriate local treatment (see preceding subdivision). Pleurisy may cause a most distressing cough, which can be greatly relieved by immobilizing the side affected with adhesive plaster.

But by far the commonest seat of cough in pulmonary tuberculosis is to be found in the trachea, bronchi, and bronchioles. The irritation may be produced either by the collected secretions, or by the inflammatory process. Sudden circulatory changes, such as are produced by arising from the horizontal to the upright position, or vice versa, or by the sudden change from a warm room to the cold outside air, tend to increase this irritation and may give rise to severe paroxysms of cough. Such sudden changes, when found to exaggerate coughing, should be avoided as far as possible. The pulmonary congestion caused by mitral disease is also productive of cough, and may occasionally be present as a complication of tuberculosis.

Two varieties of cough should be carefully differentiated: first, the dry, hacking, *unproductive* cough, out of all proportion to the amount of expectoration; and, second, the loose, easy, *productive* cough, which succeeds with little effort in raising the more or less abundant expectoration. It is important, when considering treatment, to make a distinction between these two, since the first is unnecessary and harmful, while the second is of benefit in ridding the respiratory tract of its collected secretions. A little questioning or observation of the patient will soon enable the physician to determine to which of these varieties the cough

belongs, and so to form an opinion as to the desirability of attempting to suppress it. In general, it may be said that the dryer and more unproductive and more violent the cough the more active should be the means taken to prevent it. It is a most important point that those coughs which necessitate a considerable expenditure of energy should by some means or other be controlled. If simple measures will suffice, so much the better; but, if not, then sedative drugs are the lesser of two evils and should be resorted to.

We may for convenience make four classes of the means at our disposal of controlling cough: 1st, prophylactic; 2d, suppression; 3d, local measures, and, 4th, sedative drugs.

PROPHYLACTIC MEASURES.—The patient should be instructed to avoid those acts which by experience have been found to provoke severe cough. Too much or too violent exercise may be a cause, especially if carried to the point of breathlessness. Loud talking, laughing, or singing may be factors. Getting chilled, exposure to severe winds, a sudden change from breathing warm air to cold air—any of these may be found to excite paroxysms of cough, and, if so, should be avoided. The cough produced by change of position has been mentioned. Inhaling dust, smoke, or irritating vapors of any kind is apt to be a cause. Tobacco smoking comes under this head and may have to be forbidden. Especially annoying is the cough that comes after taking food, sometimes provoking vomiting. A hot drink shortly before meals, a soft, non-irritating diet, the thorough mastication of the food, and care in not overloading the stomach may overcome the difficulty, but occasionally the vomiting is so persistent as to lead to malnutrition, and in such cases a sedative, preferably codein or heroin, must be given shortly before the meal.

SUPPRESSION OF COUGH.—This is the most important of all points in the treatment of cough. The physician should explain to the patient that all hard coughing is not only unnecessary, but is positively harmful, and should urge and insist that, by force of will power, he refrain from coughing until absolutely compelled to do so. This requires a somewhat unpleasant effort at first, but the patient who persists in refusing to yield to the impulse to cough will soon be rewarded by finding that the impulse becomes much less, that the cough is easily controlled, and that the expectoration, when ready to come up, will do so with little effort. The very act of coughing, by increasing the irritation in the respiratory tract, increases the necessity for coughing, and a vicious circle is soon formed. A convenient analogy for explaining this to the patient is that of the mosquito bite. If the desire to scratch be controlled for a few minutes, the irritation and inflammation subside; but, if the desire be indulged, instead of relief there is an aggravation of the condition. In this matter of suppressing a cough there are various little expedients that

may help. A few long, deep breaths, or holding the breath, may be tried. Sips of cold water or bits of ice are often efficacious.

LOCAL MEASURES.—If the above measures are unsuccessful, recourse should next be had to local measures for allaying the irritation in the respiratory tract. Small quantities of demulcent substances, such as mucilage of acacia, glycerrhiza, slippery elm bark, Iceland moss, or the old-fashioned linseed or flaxseed tea may be tried. Mentholated lozenges, allowed to dissolve in the mouth, are sometimes of value. All such remedies should be used with moderation lest they upset the digestion. Milk possesses demulcent properties, and often sips of hot milk will accomplish as much as any of the above-mentioned drugs, and with no damage to the digestion. Spraying the throat with a two per cent. solution of menthol in albolene is sometimes efficacious. Any of these remedies may be found to give great relief when the source of irritation is in the pharynx or upper part of the larynx. When it is lower down they are valueless. In such cases inhalations may accomplish the purpose. A very satisfactory one is the following:

R	Creosote (beechwood)	6%
	Menthol	2%
	Oil eucalyptus	12%
	Tinct. benzoin co.....	80%

A teaspoonful of the mixture should be added to a pint of boiling water in an inhaler or croup kettle, and the vapor inhaled. Or the following may be used in the same way:

R	Creosote	
	Tinct. benzoin co.	
	Oil terebinth	a. a. 10 c. c. 3iiss

Continuous inhalation of various drugs by means of a Yeo mask, or one of its modifications, has been warmly recommended by some authors, and may be tried if other methods fail to control the cough. Creosote is probably the best drug to use for this purpose.

Some patients seem to obtain relief from counterirritation over the trachea or bronchi. Tincture of iodine or a mustard plaster may be tried in this way.

SEDATIVE DRUGS.—If prophylaxis, suppression, and local measures fail to control the cough, sedative drugs become necessary. The harm of violent exhaustive cough certainly outweighs the harm such drugs may do. There is little objection to their use in far advanced cases, but in early cases they should be used only when other measures fail. They are of especial value in the severe paroxysms of coughing occurring during

the night and preventing sleep. As has been mentioned above, they may also be serviceable in the persistent cases of cough accompanied by vomiting. In cases complicated by laryngeal tuberculosis they should be resorted to as the lesser of two evils, in order to save the larynx from the severe wear and tear produced by coughing. After hemorrhage they should be used without hesitation when there is any tendency to racking cough. Of the drugs to be used codein, from $\frac{1}{8}$ to $\frac{1}{2}$ gr. (0.008-0.032 gm.), or heroin, gr. $\frac{1}{24}$ to $\frac{1}{6}$ (0.003-0.010 gm.), are most satisfactory. Either one, if continued very long, will lose its effect, when the other may be substituted. [Heroinism has been recorded and occurs after long, continued use.—Editor.] The elixir of heroin and terpin hydrate in teaspoon doses is more efficient in some cases. Severe paroxysms of cough, evidently sapping the patient's strength and throwing violent strain on the heart and circulation, may be controlled by a few inhalations of chloroform. Only in moribund cases, and when all other measures fail, should morphin be used as a remedy for cough, on account of the danger of forming the habit.

Expectoration.—Changes in the amount and character of expectoration afford an excellent index as to the progress in the lung lesions. If the lung condition is improving under hygienic treatment, there is usually a considerable decrease in the amount of expectoration. Ordinarily no especial measures should be taken to reduce the amount. If it is excessive or is increasing, it is inadvisable to allow the patient exercise. In case of a sticky, thick, tenacious sputum, difficult to raise, it may be advisable to use expectorant measures. A glass of hot water is sometimes very effectual. Either of the steam inhalations mentioned under the treatment of cough may be tried for this purpose, often with marked benefit. Of drugs, ammonium chlorid, gr. 5 to 10 (0.3 to 0.65 gm.), is probably the best. Its use alone should not be long continued, on account of the danger of causing gastric disturbance. Profuse expectoration may be in *rare* cases caused by secondary organisms. In these cases creosote or one of its derivatives will sometimes be found to have marked value in lessening the amount of the expectoration. It is best given well shaken in an ounce or two of *hot* water, about an hour after meals. Small doses (1 or 2 minims—0.065-0.120 gm.) should be used at first, and this increased a drop or two at a time up to 10 or 15 drops three times a day. The heroic doses sometimes advocated are to be condemned. Large doses have a tendency to upset the digestion, and this counterbalances any possible benefit as a pulmonary disinfectant. It is best to discontinue the drug at once; later, perhaps, to resume it again with smaller doses, if the patient complains of its causing digestive disturbance. Numerous derivatives of creosote have been introduced, guaiacol carbonate, creosotal, gomenol, etc., but they seem to have little advantage over the pure creosote.

The expectoration due to mixed infection can sometimes be much

reduced by vaccine therapy. Autogenous vaccines are preferable to the stock varieties. Culture should be grown from the patient's sputum, and the predominating organism selected from which to make the vaccines. These may be injected two or three times a week, preferably by increasing doses in the same manner as tuberculin. The initial dose for staphylococcus vaccines may be set at 25,000,000 of the killed bacteria, and this may be increased to 5,000,000,000. The limits for streptococcus or pneumococcus should be somewhat lower, from about 10,000,000 to 500,000,000.

Hemorrhage.—This distressing symptom is the *bête noir* of both patient and physician. The suddenness of onset, the sight of the blood, the choking sensation, the feeling of helplessness on account of the inaccessibility of the bleeding vessel to any direct treatment, the dread of a fatal outcome, all these can hardly fail to have a powerfully depressing effect on even the strongest-minded patient. In no other symptom or event in the course of a pulmonary tuberculosis is the rôle of the physician so important or his presence so necessary. Much depends on getting the patient quiet, both physically and mentally, as soon as possible, and, except in the case of patients who have been through the experience often, this desideratum cannot, as a rule, be secured until the arrival of the physician or nurse. It is remarkable how soon a hemorrhage will sometimes stop as soon as the patient's mental anguish and intense anxiety are put to rest by the presence or reassuring words of a calm, self-possessed physician or nurse.

Hemorrhage varies all the way from a blood-tinged sputum to a loss of blood so excessive that the patient succumbs in a few minutes. The cases of blood-streaked sputum require no other treatment than the refraining from exercise until the sputum is clear, and the prophylactic measures suggested below. All cases beyond this in which there occurs a spitting of pure blood should immediately be placed in bed and treated in accordance with their severity until the bleeding has ceased, and the danger of recurrence is past.

The first thing to be done on the occurrence of hemorrhage is to get the patient to bed. He should lie flat on his back, a pillow may be placed under his head if more comfortable, and his head turned to one side to facilitate the expectoration of the blood. He should not be allowed to talk or to use his arms, or to raise his head in order to expectorate, but the attendant should hold a basin or sputum cup to catch the blood, and should wipe it away with pieces of gauze or linen as it accumulates in the mouth.

If the patient is frightened or nervous, as is usually the case, the physician should endeavor in every possible way to reassure him, since nervousness and emotion raise blood pressure and thus are a contributory cause of hemorrhage. A few reassuring words from a physician in whom

the patient has confidence will often have a wonderfully quieting effect. Unless this is evidently sufficient to accomplish the purpose, morphin should be used without hesitation. It is best given hypodermatically in doses of $\frac{1}{8}$ to $\frac{1}{4}$ gr. (0.008-0.016 gm.), and may be repeated if necessary. Besides quieting the patient and reducing blood pressure, it also has the valuable effect of allaying the cough, which is often a dangerous factor.

An ice bag applied over the heart also has a good effect in quieting the heart action and so reducing pressure. Some advise the application of cold over the supposed site of the bleeding vessel. As this is a point usually impossible to determine, since it is decidedly dangerous to attempt any but the most superficial examination while the hemorrhage is in progress, the measure is one of very doubtful efficacy.

Various drugs besides morphin have been advocated by different authors; only a few deserve mention. As hemorrhages tend to stop spontaneously as soon as the decreased quantity of blood in the vessels has lowered the pressure and shortened the coagulation time, it is hardly accurate to attribute the favorable result to the particular drug that happened to be used at the time. As a routine measure the use of drugs, except morphin, for controlling pulmonary hemorrhage undoubtedly does more harm than good, and is to be condemned. Salt is a favorite household remedy, but there seems to be no reason for its use, and it may do harm by exciting gastric disturbance. Ergot and adrenalin, from the fact that they are known to control hemorrhage in other parts of the body, have been advocated. The evidence offered in support of either is hardly convincing. Both of them raise pressure in the systemic and so indirectly in the pulmonary circulation, exactly the thing to be avoided if the clotting is to take place. [They also cause contraction of the muscularis of the blood vessels and in this way may relieve hemorrhage.—Editor.] On the other hand, the nitrites, or pressure reducers, do influence some cases favorably, especially those associated with a high blood pressure. It is well to control their administration by blood pressure estimations at frequent intervals. If the pressure falls below 120 mm. they should be discontinued. At the beginning amyl nitrite is of the greatest value on account of the rapidity of its action. A pearl of amyl nitrite should be broken in a handkerchief and inhaled, if the pulse feels hard. Since its action is as transitory as it is rapid, it should be followed by nitroglycerin, gr. 1/100, or sodium nitrite, gr. 1, of which the effects are of much longer duration. The dose may be repeated every three or four hours if the pressure still remains high. Erythrol tetranitrate, gr. $\frac{1}{2}$ to 1, often acts better than either of the above, and in many patients seems less apt to cause gastric disturbance and headache.

It is also advisable, in the case of continued or repeated hemorrhages, to make a determination of the coagulation time of the blood. If this is much prolonged, which happens but rarely, calcium lactate, gr. 15 to

20 (1.0-1.3 gm.), should be given three times a day. Gelatin, either by mouth or subcutaneously, has also been recommended by some for this purpose.

In severe hemorrhages the application of ligatures to one or more of the limbs for the purpose of reducing the total quantity of blood in the circulation is a measure worthy of trial. The ligatures should be tight enough to restrict the venous, but not the arterial, circulation. In releasing them one should be careful to allow a considerable interval to elapse after the removal of each ligature, in order that too great a quantity of blood may not be admitted into the circulation at once.

Following a severe hemorrhage nothing should be given by mouth for several hours, except a little cracked ice, or occasional sips of water if there is thirst. As long as any bleeding persists the diet should be restricted. Some authorities advocate a liquid diet, while others favor one in which the fluids are greatly restricted. The greatest danger seems to be in overloading the gastrointestinal tract with either fluids or solids, and so throwing an extra burden on the circulation. The most rational plan would seem to be to diminish proportionately the quantities of both fluids and solids that constitute the patient's ordinary diet, the amount of restriction varying with the severity and persistence of the hemorrhage. It is better to allow small quantities of food at more frequent intervals rather than to give any large amount at one feeding. Alcohol, tea, and coffee should be prohibited.

It is important that the bowels be kept freely open. Violent purging, on the other hand, may be harmful on account of the frequent strain in the act of defecation. Laxatives, such as cascara, compound licorice powder, or a pill of aloin, strychnin and belladonna, may be given each night, and enemata used if these are ineffectual.

As to the after-treatment of hemorrhage, this will vary much with the severity of the case. After a small hemorrhage, that is to say, only one or two mouthfuls of blood, the patient should be kept in bed for one or two days and then, if the sputum is clear and temperature normal, he may be gradually allowed to resume his usual life. After larger hemorrhages he should be kept in bed and under close observation for several days. The greatest danger from hemorrhage is not the anemia and prostration from loss of blood, but the chance of the extension of the diseased area or even the production of a pneumonia from the blood aspirated. Symptoms of such a complication should be carefully watched for. A rise of temperature following hemorrhage is not at all uncommon, and is probably due to absorption of blood. Such a temperature should subside within a few days, and any persistence of it should lead to the suspicion of renewed activity of the tuberculous process. Without such a complication the loss of blood, even from a large hemorrhage, is soon repaired, and in many cases the patient seems none the worse. A tonic of iron or arsenic or

small doses of strychnin may be of service during this stage of repair. Immediately following large hemorrhages, if there are symptoms of shock from loss of blood, salt solution by rectum, or better by hypodermoclysis, should be administered. With patients subject to hemorrhage much may be done by prophylactic measures. Such patients should avoid any violent exercise, loud laughing, shouting, or singing. Tea, coffee, or alcohol should be used sparingly, if at all. Overloading the stomach or, in fact, excesses of any sort should be avoided. On the appearance of blood-streaked sputum such patients should go to bed and remain there until all traces of blood have disappeared.

Gastrointestinal Disturbances.—These are common among tuberculous patients, though becoming less so as the practice of forced feeding is abandoned. Most patients still hold more or less firmly the conviction that “stuffing” is an essential in the cure of tuberculosis. So firmly has this notion become rooted in the minds of the laity that the physician with modern dietetic ideas is apt to meet with considerable opposition, open or secret, when he attempts to enforce them. Undoubtedly many of the stomach and intestinal symptoms complained of by patients are due to such “stuffing,” either in the past or present. Anorexia, flatulence, constipation, diarrhea, nausea, and vomiting, or abdominal pain are the symptoms most commonly met with. When a patient persistently complains of one or more of these symptoms the first important point to determine is the nature and amount of his diet. The methods for doing this and the proper dietary for tuberculous patients are considered elsewhere in this article. If the patient is found to be greatly exceeding this normal requirement, a simple reduction of the amount eaten will often clear up the symptoms. An excess of proteid, even though the total amount of food be not in excess, is often productive of gastrointestinal disturbance. In this case the patient should be instructed to eat more carbohydrate and less proteid, or, in plainer words, more cereals, bread, and vegetables, and less meat and eggs. Sometimes a patient will be found to be eating excessively of one particular article of food, especially milk or eggs or meat, and in such case a simple curtailment of the amount of these articles may be found sufficient. If after these corrections in the diet symptoms still persist, a more serious impairment of digestion or possible organic lesions in the intestines should be suspected. Of the various tests which have been proposed or used for testing the intestinal functions, the most satisfactory is that of Adolph Schmidt. Simply stated, this method consists of the careful examination of the feces obtained after a test diet. The test diet used at the Loomis Sanatorium modified slightly from the one described by Schmidt is as follows:

Breakfast.—One soft-boiled egg; two slices toast with butter; one bowl of oatmeal, strained, with sugar and cream; one glass milk; one cup coffee (if desired).

Dinner.—One-quarter pound finely chopped round steak (slightly broiled); one-half pound mashed potatoes; two slices of bread or toast with butter; one or two glasses of milk.

Supper.—Same as breakfast.

This diet is easily digested by normal persons, furnishes a sufficient number of calories to meet the nutritional requirements of the body, and contains the proper proportion of proteid, fat, and carbohydrate. The diet is given the patient for three days, or until certain that the feces are coming from it. It is well to give a charcoal tablet with the first breakfast, note the time which elapses before the black appears in the stools (which furnishes a rough estimate of the mobility of the gastrointestinal tract), and then to continue the diet until the black has entirely disappeared before selecting a specimen for examination. The stool is first examined macroscopically for mucus, blood, pus, parasites, etc., and then a small portion finely ground in a mortar is pressed between two glass plates and inspected for any abnormal constituents or undigested food remains. Normal stool from the test diet should be homogeneous, with no remains of undigested food. In abnormal conditions one may detect after a little practice connective tissue, muscle, potato, or fat remains, or mucus flakes. Next, a microscopical examination should be made, by which the macroscopical is confirmed, and undigested muscle fibers, starch cells, or fat detected. A few chemical tests should also be made, i. e., the reaction to litmus, the sublimate test for bile, and the incubator test for gas formation. In the latter test a small amount of feces is placed in a special fermentation tube, allowed to incubate at 37° C. for 24 hours, and then inspected to determine the formation of gas. Gas formation, unless very slight, is pathologic. It may be due either to putrefaction or to fermentation changes. If the former, the reaction will have become more alkaline; if the latter, more acid than it was originally. Finally, smears should be made and examined for tubercle bacilli.

By following this method carefully very valuable information can be obtained as to the nature of the digestive disturbance. Enteritis or colitis may be diagnosed by the presence and character of mucus or pus. If these lesions be tuberculous, there will usually be found large numbers of tubercle bacilli in the mucus or throughout the stool. A diagnosis of intestinal tuberculosis should not, however, be made on the presence of tubercle bacilli in an otherwise normal stool, since there is always the possibility that they may have been swallowed, or even that they may be non-pathogenic acid-fast organisms.

Functional disturbances of digestion may also be diagnosed with the aid of the diet. Undigested connective tissue remains are held by Schmidt to indicate impaired gastric digestion. This diagnosis may be confirmed

by the use of the stomach tube for gastric analyses. Administration of dilute hydrochloric acid will often materially help this condition.

Intestinal indigestion is to be diagnosed when an excess of fat, muscle fibers, or starch is found. A fermentative intestinal dyspepsia is not uncommon among tuberculous patients, showing itself clinically by the symptoms of flatulence, colicky pains, and often diarrhea, and in the feces examination by the presence of starch granules (recognized macroscopically by their reaction with iodine), acid reaction, and gas formation. This form of indigestion can often be materially benefited by giving a carbohydrate-free diet for a few days, followed by a gradual return to a normal diet, or to one in which the carbohydrates are restricted.

Insufficiency of proteid digestion in the intestine is shown by the presence of muscle fibers, sometimes associated also with putrefactive changes. Flatulence and diarrhea may also be present in this form. This type can be benefited by a diet in which the proteid is restricted. Meat should be used very sparingly, if at all, and the proteid necessary to maintain nutrition taken in the form of milk and vegetable proteids. Lactic acid bacilli, in the form of buttermilk, are also of value when there is putrefaction.

If thorough feces and stomach tests are negative, if abdominal examination reveals nothing abnormal, if a diet proper as to quantity and composition is being taken, and yet, in spite of the apparently normal condition, the patient continues to complain of symptoms referable to the digestive tract, then the trouble is in all probability purely mental. A thorough explanation of this fact should be given to the patient, and then every effort made to get his attention away from the digestive tract. Drugs should not be used in this condition, as they serve to keep the attention on the digestion.

Anorexia.—This symptom, so common in tuberculosis, is probably due to the toxemia of the disease. As the latter is reduced under treatment the appetite usually improves greatly. A little tonic, such as nux vomica, strychnin, or gentian, before meals, or small doses of alcohol in the form of wine, beer, or ale with the meals, will often stimulate a flagging appetite and enable the patient to consume a normal quantity of food. If the anorexia and repugnance to food are so great that the patient can eat very little at one time, it is well to give frequent small feedings, one every two hours, for instance, of easily swallowed foods, such as milk, raw eggs, beef juice, albumin water, soft toast, etc., rather than attempt the ordinary three large meals. The patient will usually succeed in taking more food with less trouble by this method.

Constipation.—The treatment of this troublesome complication does not differ from that in the non-tuberculous, except that it is more important that it be not neglected. A dose of calomel and salts often clears up surprisingly, for the time being, the headache, lassitude, and general de-

pression associated with a sluggish bowel. If a constant laxative is necessary, fluid extract of cascara sagrada is as satisfactory as anything. Agar-agar is very effectual with a few patients, but most tire of it rather quickly.

Diarrhea and Intestinal Tuberculosis.—The acute attacks of diarrhea common in summer are best treated by a dose of castor oil, followed by bismuth subnitrate or subgallate in 20-grain doses (1.30 gm.) every three or four hours, and with a soft diet with boiled milk as its basis until the trouble is checked.

The diarrheas associated with fermentative or putrefactive intestinal indigestions have been considered above. An initial dose of castor oil and a few doses of bismuth are of advantage at the start, although the main reliance must be on proper diet.

Chronic diarrheas in the tuberculous are usually due to intestinal tuberculosis. Local treatment is very unsatisfactory. Occasionally, perhaps more often than we suspect, intestinal lesions clear up under hygienic treatment. When the symptoms are pronounced and persistent, however, there is little to be hoped for, and palliative treatment is all that is left us. A soft diet sometimes gives relief. Some patients seem to do better on a diet in which the fluids are restricted. Fruits and green vegetables are apt to cause distress and may have to be prohibited. As a matter of fact, however, in most cases one diet seems to be about as good, or as bad, as another, and there is no harm in allowing the patient to have whatever he desires. Bismuth often relieves the symptoms somewhat, but for the intense and constant abdominal discomfort characteristic of these cases opium usually furnishes the only means of relief. Colonic irrigations with silver nitrate (1-5,000 solution) in certain cases seem to have a palliative effect and may be tried.

Fever.—See Management During Stage of Active Process.

Night Sweats.—Like fever, these are a symptom of toxemia. The treatment should be directed against the cause instead of the symptom. As a rule, they clear up as the patient's condition improves without other treatment. If severe and persistent, there are certain palliative measures which may reduce the sweats and make the patient more comfortable.

It is important that the covering be not too heavy. Flannel night-clothes should be worn, and only sufficient blankets to prevent chilling. A thorough sponging with alcohol, 50 per cent., or vinegar and water at bedtime is a help. A cold compress to the chest is sometimes effectual. A glass of cold milk on retiring or when awake during the night seems useful in certain cases. One or two teaspoonfuls of whiskey or brandy may be added to the milk or given separately at bedtime. Of other drugs camphoric acid, 15 to 30 gr. (1.0 to 2.0 gm.), given at bedtime, may be tried. Atropin, 1/200—1/100 gr. (0.0005 to 0.001 gm.), best given hypodermatically, is the most effective drug, and may be used in severe sweats

in the late stages. It often causes an unpleasant dryness of the throat, and care should be exercised in its use.

Dyspnea.—The shortness of breath on exertion often complained of by patients who have been for some time on little or no exercise is of small moment, in the absence of other symptoms, and usually disappears as the exercise is gradually increased and the heart muscle thus restored to its proper tone.

In advanced cases, especially of the fibroid type, dyspnea may be a distressing feature, and is here probably due to lack of sufficient functioning lung tissue. Since the lung tissue cannot be restored, there is no cure for it. The patient should be warned against any overexertion.

The dyspnea due to extensive pleural adhesions often improves under graduated exercise. That due to a rapidly developing effusion or pneumothorax should have treatment directed toward those complications. Occasionally attacks of true bronchial asthma arise in tuberculosis, and here the treatment, unsatisfactory though it is, does not differ from that of the same condition in the non-tuberculous.

Finally, there remains the dyspnea of the last stages, due to a failing circulation, where treatment can be only palliative. Strychnin, nitroglycerin, or, more often perhaps, morphin frequently seem to give relief. Inhalations of oxygen sometimes conduce to the patient's comfort.

Pain in the Chest.—This is of frequent occurrence and varies from a dull, indefinite ache, through all gradations up to the excruciating knife-like pains of acute pleurisy. The origin of the pain is often difficult to determine, for it may be from pleurisy (either the rubbing of inflamed surfaces or the dragging on pleural adhesions), or from intercostal neuralgia, or from myalgia of the intercostal muscles. But, whatsoever the cause, the treatment is the same. If the pain is so slight as to cause little discomfort, it should be disregarded. If more severe counterirritation should be used over the painful area, either a brisk rubbing with wintergreen or chloroform liniment, or the painting with tincture of iodine, or the application of mustard plasters. If these measures do not suffice, or in any case if breathing or coughing causes severe pain, the affected side should be strapped with strips of adhesive plaster. These should be applied at the end of forced expiration, and drawn as tightly as possible, so as to restrict to the greatest extent all motion of the chest on that side. In very severe cases of pleural pain hypodermics of morphin may be necessary.

Insomnia.—Not infrequently patients attempting to sleep out of doors find sleeping difficult, either on account of the unaccustomed noises, the increased light, the wind, or other novelties in their surroundings. Usually the condition rights itself after a few nights, but in very light sleepers this may not be the case, and they should then be advised to sleep in a well-ventilated but dark and quiet room. Those suffering from insom-

nia should avoid physical or mental excitement during the evening. A glass of hot milk at bedtime or during the night is often helpful. With patients who are accustomed to it a glass of beer may act as a "nightcap." Of drugs, bromids, though not as effectual as the hypnotics, veronal, trional, paraldehyd, etc., are safer and less depressing and should be used first, provided the condition does not yield to simple measures.

Menstrual Disturbances.—Amenorrhea is a not infrequent symptom of tuberculosis. It is probably a conservative measure on the part of nature for curtailing any unnecessary expenditure of energy, and no treatment should be directed against it. Severe dysmenorrhea, menorrhagia, or metrorrhagia, if present, probably arise from other causes than pulmonary tuberculosis. If persistent an examination should be advised to determine if possible any local abnormality or pathological process.

Anemia.—This is usually more apparent than real, and a blood count and hemoglobin estimation should always be made before beginning treatment. If anemia is actually present, iron and arsenic should be administered.

Pleural Effusion.—There has been great difference of opinion as to the desirability of aspirating pleural effusions. The generally accepted procedure has been to aspirate any except very small effusions as soon as diagnosed. On the other hand, there is considerable evidence pointing to the fact that a moderate effusion is a beneficent, purposeful effort on nature's part to relieve the strain on diseased tissues. The effusion acts as a splint to the diseased lung, limiting its motion and allowing it needful rest. There is no doubt that many cases do show greater improvement both in general and local condition during the presence of an effusion. For this reason our method of late years at the Loomis Sanatorium has been, in the absence of cardiac or pulmonary distress, to allow a moderate or small effusion to remain until absorbed, and even to regard its presence with satisfaction. If, however, the effusion is so large as to cause respiratory or cardiac distress, or if the initial fever which so often accompanies its development does not after a few days subside, then aspiration of at least a portion of the fluid is advisable.

Empyema.—If signs indicate fluid in the pleural cavity and symptoms point to pus, a needleful of the fluid should be aspirated for diagnosis. If the fluid is purulent, thoracotomy should be performed and drainage established without delay.

Pneumothorax.—This, as is the case with effusion, is often a beneficial event. If, as sometimes happens, it is so extensive or of such sudden onset as to cause severe collapse, the patient should be kept at absolute rest and heart stimulants used if necessary. In these cases the attempt may be made to aspirate some of the air, though this measure is of doubtful efficacy (see Vol. III, Sect. II, Chapter V).

Coryza and Bronchitis.—The common "cold" is not to be regarded

lightly in the case of the tuberculous, for it often seriously retards the progress of a favorable case, or hastens the decline of an unfavorable one. Many of these "colds" are doubtless due to the influenza bacillus. As prophylactic measures the wearing of sufficient clothing, varying according to the season, the avoidance of overheated, "stuffy" rooms, and the daily cold sponging of neck and chest are important. At its onset a cold can sometimes be aborted by a hot foot bath, hot drinks, a dose of Dover's powder, and rest in bed in a warm but ventilated room. Small doses of atropin or belladonna sometimes afford relief. The salicylates, especially aspirin, are often of value, especially if there is general aching or discomfort. Aspirin may be given in 5 to 10-gr. (0.30-0.60-gm.) doses every three hours. For the stuffiness in the head and the clogging of the nasal passages spraying the nares by means of an atomizer furnishes the greatest relief. Adrenalin solution (1 to 10,000) may be used first, followed as soon as the hyperemia is reduced by an oil spray, the following being a good prescription:

R	Menthol	gr. 10	gm. 1.0
	Camphor.....	gr. 10	gm. 1.0
	Eucalyptol.....	min. 5	gm. 0.5
	Olei rosæ.....	min. 1	gm. 0.1
	Alboleni q. s., ad.....	oz. 1	gm. 50.0

Instead of spraying, a medicated ointment may be rubbed into the anterior nares and allowed to melt and run back through the nasal passages. The following may be used for such purpose:

R	Boric acid	gr. 10	gm. 1.0
	Menthol.....	gr. 2	gm. 0.2
	Unguenti aquæ rosæ.....	oz. 1	gm. 50.0

The throat and nasopharynx should be sprayed with Dobell's solution at frequent intervals, if pharyngitis be present. Bronchitis is best treated by inhalations, either moist inhalations, such as described in the section on "Cough," or by means of sprays from an atomizer nebulizer. A good prescription for the latter purpose is as follows:

R	Menthol.....	gr. 20	gm. 2.0
	Creosoti.....	min. 20	gm. 2.0
	Olei eucalypti.....	dr. 4	gm. 25.0
	Alboleni q. s., ad.....	oz. 2	gm. 100.0

If repeated colds occur it is advisable to attempt to isolate, if possible, the offending organism from the secretions and give a course of vaccine therapy.

Otitis Media.—This is not an uncommon tuberculous complication, occurring in 17, or 3 per cent., of 550 patients in all stages of the disease treated at the Loomis Sanatorium. Its treatment should be delegated to the aural specialist.

Tuberculous Abscesses and Fistulæ.—The most common seat of these is in the tissues about the rectum, but they also not infrequently occur in the chest wall. As soon as the presence of pus is diagnosed the abscess should be opened, irrigated, and drained. The abscess walls may be mopped with tincture of iodine diluted one-half with alcohol, a very efficient germicide and a stimulation to the production of healthy granulation. Old fistulæ may occasionally be cured by injection of Beck's bismuth paste (bismuth subnitrate, 33 per cent., in vaselin), and this should be given a trial, but for most cases the only radical cure is surgical excision. [For external application, where intoxication is most common, bismuth subcarbonate should always be preferred. In this way nitrite intoxication, the most fatal form, is prevented.—Editor.] The general condition of the patient should be very carefully considered, however, before any operation requiring a general anesthetic is attempted.

DRUG TREATMENT

For centuries therapists have been seeking a specific remedy for tuberculosis. The number of drugs which have been tried and found wanting is legion. When the causative agent of tuberculosis was discovered by Koch in the tubercle bacillus a definite point of attack was established, and the object of drug therapists at once became that of finding some antiseptic agent capable of killing in the tissues the invading organisms. For this purpose numerous agents, known to kill the tubercle bacillus experimentally in vitro, have been administered by mouth, by inhalation, by subcutaneous, intravenous, or intratracheal injection, or even by direct injection through the chest wall into the pulmonary tissue. None of these attempts has been successful enough to stand the test of time. The idea is perfectly logical and is analogous to the quinin treatment of malaria or the mercury or arsenic treatment of syphilis. Unfortunately, however, there are insurmountable difficulties in the way of applying any specific drug treatment to pulmonary tuberculosis. The tubercle bacillus is much more resistant, probably on account of its capsule, to all disinfecting agents than are most other bacteria, and it seems unlikely that any agent will be found which can be used in sufficient concentration to kill the tubercle bacillus without seriously injuring the host. Furthermore, the pathology of tuberculosis is such that the bacilli have their residence either in dead or dying caseous material or within the fibrous, non-vascular tubercle, alike inaccessible either by the blood stream or by the inspired air. Although prediction is always hazardous, yet it seems

extremely improbable that the future holds any promise for this method of attack upon tuberculosis, or that any specific drug therapy will ever be one whit more successful than have past efforts. Not a year passes, and undoubtedly not one will pass until the scourge of tuberculosis has at last been conquered, that new "tuberculosis cures" are not put forward, enthusiastically advocated, and widely exploited, only to fall by the wayside after a longer or shorter vogue, and have their places taken by others of no greater worth or permanency. Among such "false specifics," as they have been aptly termed, may be mentioned creosote, alcohol, cod-liver oil, arsenic, cinnamic acid, iodine, ichthyol, calcium, silver, carbolic acid, camphor, formaldehyd, turpentine, phosphorus, mercury, lecithin, radioactive compounds, etc. The wise physician will exercise a well-founded skepticism and, in view of past failures in this field, will refuse to be carried away by glowing accounts of marvelous curative properties in this or that new drug.

This criticism of drug therapy is aimed solely at the drugs used as specifics, those for which the claim is made that they exert any directly curative effect on tuberculosis. In the symptomatic treatment a few drugs are of considerable value. These have been considered under that heading. Undoubtedly many patients have been harmed by overdrugging, and in general it is a good maxim to avoid the use of drugs when other measures will suffice.

TUBERCULIN THERAPY

The subject of tuberculin therapy in pulmonary tuberculosis is attracting wide attention at present. Opinion as to its value varies all the way from hostile skepticism to enthusiastic endorsement. By some it has even been declared to be a specific, a claim unwarranted by the facts and certain to do more harm than good. On the other hand, the accumulated evidence of many years does seem sufficient to warrant the conservative statement that tuberculin, when judiciously given in carefully selected cases as an adjunct to the hygienic treatment, has a definite therapeutic value.

Before entering into detail on the subject a word of emphatic warning should be sounded against its indiscriminate use. It is a powerfully toxic agent and one capable of doing much harm if improperly used. Only those physicians who are willing to devote considerable time to the study of the subject and who have had experience in observing and handling tuberculous patients should attempt its use.

Historical.—The history of the use of tuberculin dates from 1890, when Robert Koch, after experimentation, proposed its use as a cure for tuberculosis. Koch's announcement caused widespread enthusiastic hopefulness that at last the long sought specific in the treatment of tuberculosis had been found. An unrestrained and injudicious use of

tuberculin then began, attended with many disastrous results. The inevitable reaction followed, culminating in 1891 with Virchow's protest, based on unfavorable autopsy findings, against its use. A strong prejudice against tuberculin resulted and continued during the next decade, although a few believers still continued to use it and experiment with it.

In 1903 Wright (32) began his publications on vaccine therapy and the opsonic index, demonstrating the necessity of proper dosage and proper interval between doses. Again tuberculin began to be widely used. From this time may be dated the present hopefulness, tempered by past experience, as to its therapeutic possibilities.

Theory of Action.—Tuberculin may be defined as a product prepared from the tubercle bacillus, its active principle being the toxin of the bacillus. Its exact chemical nature is undetermined, but it belongs to the protein group.

The scientific basis for tuberculin therapy is the theory of immunity, founded on the principle that when a foreign toxic protein is introduced into the system the tissues respond by producing specific neutralizing anti-substances or immune bodies. There are two phenomena following tuberculin injections which prove that an immunity is produced: (1) a demonstrable increase of specific antibodies to tuberculin in the blood, opsonins, agglutinins, precipitins, "antituberculins," etc.; (2) an increased tuberculin tolerance. Tuberculin therapy is an attempt to utilize to the fullest extent this inherent defensive immunity mechanism, by stimulating the tissues to produce antisubstances against the toxins of the tubercle bacillus, and to establish a toxin tolerance.

Unfortunately, as has been clearly established by clinical observation, by autopsy, and by animal experimentation, the tolerance established to tuberculin by tuberculin injections is not an immunity to tuberculosis. The individual after treatment is able to tolerate large doses of tuberculin, but it cannot be demonstrated that his immunity to the tubercle bacillus itself has been increased. Possibly this means that the immune substances produced are of an antitoxic but not of a bacteriolytic nature. Only the presence of living bacilli seems capable of producing a bacteriolytic immunity, and a vaccination with living organisms, although it has been attempted, is hardly feasible at present. At any rate, it would seem theoretically as if the tuberculin tolerance would help the system to overcome the toxemia caused by the tubercle bacillus, and the beneficial effects of tuberculin therapy may be due to this fact.

Varieties of Tuberculin.—Ever since Koch made public his first work with tuberculin there has been ceaseless experimentation directed toward the production of an ideal tuberculin, new preparations being constantly advertised and exploited.

As a matter of fact, good results seem to be obtained with almost any of the tuberculins, and it would be difficult to award first place to any

one. The object sought in the preparation of a good tuberculin is to secure and concentrate, with as little alteration as possible, all of the immunity-producing substances in the tubercle bacillus. Theoretically, the unheated preparations made from the dead bodies of the bacilli themselves would seem best to meet this requirement, but practically such preparations cannot be said to give any better results than some of those made from culture fluids or from extracts. It would seem, therefore, that the latter also contain the desired specific substances.

Various attempts have been made to analyze tuberculin into its different constituents, with the idea of preserving the immunizing properties and discarding the toxic ones. As it is probable, according to the accepted theories of immunity, that the toxic portion of tuberculin is the part that stimulates the tissues to the production of immune substances, such endeavor would seem futile. It may be given as a dictum that any tuberculin preparation which is incapable of producing a tuberculin reaction is also incapable of producing a tuberculin immunity.

The most commonly used preparations are the following:

Old Tuberculin, Koch (O. T.).—A pure culture of tubercle bacilli of six weeks' growth on five per cent. glycerin bouillon is evaporated to one-tenth its volume and filtered. It contains all the soluble products of the tubercle bacillus in 50 per cent. glycerin solution. It has the disadvantage of having had heat used in its preparation.

New Tuberculin, Koch, or Tuberculin Residue (T. R.).—A virulent culture of tubercle bacilli is dried in vacuo, finely pulverized in a mortar, treated with physiological salt solution, centrifugated, and the supernatant fluid discarded. The residue is ground into an emulsion with 20 per cent. glycerin. Each c. c. contains 2 mg. solid substance in a 20 per cent. glycerin solution.

Bacillen Emulsion, Koch (B. E.).—A virulent, finely pulverized culture of tubercle bacilli is made into an emulsion with 50 per cent. glycerin. Each c. c. contains 5 mg. solid substance in 50 per cent. glycerin solution.

Bouillon Filtrate, Denys (B. F.).—A filtrate from a bouillon culture of tubercle bacilli. It contains all the soluble products of the tubercle bacillus in a bouillon medium.

Spengler (27) in Germany and Raw in England have both advocated using in pulmonary tuberculosis tuberculin derived from bovine bacilli, on the ground that there is an antagonism between the human and bovine forms. This point has not been proved, however, nor has any marked superiority of the bovine tuberculin been demonstrated.

The use of homologous tuberculins, those made from a culture of the patient's own bacilli, has also been attempted. It has not been demonstrated that these act any more efficaciously than the stock preparations. The method is so much more difficult and time-consuming that, unless

obvious advantage in its favor can be shown, it is not likely to be much used.

Probably Koch's "B. E." and Denys' "B. F." are being more extensively used than any other varieties, and either is satisfactory. In fact, success in tuberculin therapy seems to depend much more on the proper selection of cases, correct dosage, and careful attention to details in the administration than on the particular variety of tuberculin used. "B. E." is a more powerful toxin than "B. F." and more apt to cause severe reactions if injudiciously used, but in careful hands it gives eminently satisfactory results.

Method of Dilution.—Whatever the variety selected, the stock solution as obtained from the manufacturer's laboratory is too concentrated a form for immediate administration, and the first step is to secure convenient dilutions. Dilutions ready for use can be bought directly from many of the large drug houses, and for the occasional user of tuberculin this is the safest and most satisfactory method. Those who are using it



FIG. 10.—INSTRUMENTS AND APPARATUS REQUIRED FOR TUBERCULIN ADMINISTRATION.

extensively, however, find it preferable to make up their own dilutions. A convenient method is as follows:

The necessary instruments are a liter flask containing sterile physiological salt solution (.85 per cent.) to be used as diluent; a 10 c. c. pipette graduated to .1 c. c.; a 1 c. c. pipette graduated to .01 c. c.; several small (not less than 10 c. c. capacity) wide-mouthed bottles in which to keep the dilutions. These should be of amber glass, as tuberculin deteriorates on exposure to light. Instead of corking these bottles, a much more convenient method is, after filling them, to cover their mouths with thin

rubber test-tube caps, through which the hypodermic needle can be thrust and the required dose withdrawn, thus saving repeated uncorking. The pipettes and bottles should be sterilized by boiling before use, and aseptic precautions observed in the dilution. Accuracy of dilution is of prime importance, or severe tuberculin reactions may be the penalty. For this reason it is advisable to standardize carefully each new pipette before using it, and determine that it is correctly calibrated. The small 1 c. c. pipette should be used only for the tuberculin solution, and the large pipette for measuring the salt solution, thus avoiding contaminating the latter with tuberculin and interfering with the accuracy of dilution. Before changing from one solution to the next, the small pipette should be thoroughly rinsed in sterile water.

The most convenient system of dilution is the decimal, making successive dilutions containing .1 gm. tuberculin to 1 c. c. of solution, .01 gm. to 1 c. c., .001 gm. to 1 c. c., etc., each solution thus being one-tenth the strength of the preceding. Each succeeding dilution is made by taking 1 c. c. of solution from preceding bottle and adding 9 c. c. of salt solution to it. This scheme should be followed beginning with the stock solution in the case of "O. T." or "B. F." With "B. E." or "T. R." it is best to compute the dilutions according to the amount of solid substance per c. c. Accordingly the stock solution should first be diluted to make .001 gm. solid substance to 1 c. c.; and the succeeding dilutions then made as above. By making successive dilutions in this way each from the preceding bottle, there is much less chance of error than when the attempt is made to make the higher dilutions directly from the original. The bottles should be clearly labeled according to the amount of tuberculin per c. c., and it will be found convenient also to number each dilution according to the decimal place, the labels reading, for instance: No. 1, .1 gm. to 1 c. c.; No. 2, .01 gm. to 1 c. c.; No. 3, .001 gm. to 1 c. c., etc. Dilutions to the seventh place will usually be sufficient for all purposes, the weakest solution being No. 7, .0000001 gm. to 1 c. c. By using a 1 c. c. hypodermic syringe graduated to .01 c. c., any required dose from .00000005 up to 1 c. c. of pure tuberculin can be quickly and accurately obtained.

The following scheme, modified somewhat from one devised by Law-
-rason Brown, will perhaps make the foregoing description clearer:

	VARIETY OF TUBERCULIN = STRENGTH OF ORIGINAL =	"O. T." or "B. F." 1 gm. to 1 c. c.	"T. R." .002 gm. solid substance to 1 c. c.	"B. E." .005 gm. solid substance to 1 c. c.
SOLUTION	To make 10 c. c. of solutions of following strengths	Take	Take	Take
No. 0.....	1 gm. to 1 c. c.	10 c. c. Tuberculin		
No. I.....	.1 gm. to 1 c. c.	1 c. c. Tuberculin 9 c. c. Diluent		
No. II.....	.01 gm. to 1 c. c.	1 c. c. Solution I 9 c. c. Diluent		
No. III.....	.001 gm. to 1 c. c.	1 c. c. Solution II 9 c. c. Diluent	5 c. c. Tuberculin 5 c. c. Diluent	2 c. c. Tuberculin 8 c. c. Diluent
No. IV.....	.0001 gm. to 1 c. c.	1 c. c. Solution III 9 c. c. Diluent	1 c. c. Solution III 9 c. c. Diluent	1 c. c. Solution III 9 c. c. Diluent
No. V.....	.00001 gm. to 1 c. c.	1 c. c. Solution IV 9 c. c. Diluent	1 c. c. Solution IV 9 c. c. Diluent	1 c. c. Solution IV 9 c. c. Diluent
No. VI.....	.000001 gm. to 1 c. c.	1 c. c. Solution V 9 c. c. Diluent	1 c. c. Solution V 9 c. c. Diluent	1 c. c. Solution V 9 c. c. Diluent
No. VII.....	.0000001 gm. to 1 c. c.	1 c. c. Solution VI 9 c. c. Diluent	1 c. c. Solution VI 9 c. c. Diluent	1 c. c. Solution VI 9 c. c. Diluent

The original tuberculin and all dilutions should be kept, when not in use, in the ice box. Fresh dilutions should be made up at least every two weeks. Phenol .5 per cent. may be added as a preservative to the salt solution used as diluent, though with care as to ordinary aseptic precautions the solutions will be found to keep perfectly well without it. Any solutions which become at all turbid or cloudy should be discarded.

Selection of Patients.—In determining which patients are likely to receive benefit from tuberculin and which harm, the nature of tuberculin, the manner in which it affects the system, and the object sought for in its use, as explained above, should be kept clearly in mind. Much of the success in its use will depend upon the care with which cases are selected. To give it indiscriminately to all patients is not only an illogical measure, but one likely to do much harm.

The chief object of the physician in the treatment of pulmonary tuberculosis should be to assist nature to build up a defensive immunity mechanism in the patient. Climate, change of scene, fresh air, diet, rest, and exercise, all these are used only as a help and stimulus to the organism in building up its own immunity. Tuberculin is merely another adjunct to this armamentarium which the physician has at his disposal. It should be so regarded and not as a specific. Each case should be studied individually and those measures selected which seem best calculated to raise that particular patient's resistance to the highest point possible.

Primarily the question resolves itself as to whether the system is making full use of its defensive immunity mechanism, whether the latter will stand further stimulation, and, if so, whether such stimulation can best be supplied by autoinoculations, by tuberculin, or by a combination of both. In only a comparatively few cases will tuberculin be the means indicated.

If the patient's system is already overwhelmed by toxemia, as shown by fever, rapid pulse, digestive disturbance, malnutrition, or other severe constitutional symptoms, it is clearly unwise to add any further toxin, either by absorption from the patient's own focus, as would be the result of exercise, or from without, as would be the case with tuberculin. We cannot agree either on theoretical grounds or on the basis of clinical results with those who advocate giving tuberculin to febrile cases. In cases where the disease is acute it is just as absolutely contraindicated and for the same reason as is exercise.

In the terminal stages, even of chronic cases, the immunity mechanism becomes exhausted. In such moribund cases, therefore, tuberculin can do no good and should not be used. Severe complicating affections, such as nephritis, diabetes, uncompensated heart lesions, epilepsy, etc., should also be considered contraindications.

On the other hand, in cases without fever or severe constitutional disturbance there are no contraindications to tuberculin. It is unlikely

that any harm can be done the patient by a proper use of the drug, even though no benefit should result. A majority of these cases will so successfully establish an immunity on a system of "autoinoculation," by graduated exercise, that it is a question whether anything further is gained by using tuberculin. There will, however, be found a considerable number of these non-acute cases in whom "autoinoculation" does not seem to meet the requirements. The progress toward recovery comes to a standstill, as shown by weight, amount of sputum, continued presence of bacilli, physical signs, etc.; such cases, in other words, as have become "quiescent," but in which nature seems unable to go any further toward effecting a "cure." Among such cases will be found the greatest field for tuberculin therapy. Such patients should by all means be given the chance of benefit that tuberculin may bring.

Many tuberculous complications of pulmonary tuberculosis are greatly benefited by a course of tuberculin. This is especially true of glandular, osteal, and genitourinary complications. Laryngeal tuberculosis often, and intestinal tuberculosis occasionally, clear up surprisingly. On the other hand, in tuberculosis of the central nervous system tuberculin should not be used.

To sum up, then, the wisest course to pursue in regard to the selection of patients for tuberculin would seem to be, after excluding those absolutely contraindicated, to endeavor first, if possible, to secure the necessary resistance by means of the "autoinoculation" method, and in those patients in whom this seems ineffectual to supplement it by tuberculin.

Before starting a tuberculin course a thorough explanation should be made to the patient of the length of time required if any results are to be attained. Only such patients as are willing, after such explanation, to submit to the long and tedious treatment and to coöperate faithfully with the physician in carrying out all its details should start upon it.

Method of Administration.—The subcutaneous method has been the one most universally used, and the consensus of opinion is that it is far superior to any other. Other methods tried have been the intravenous, oral, rectal, by inhalation, and by inunction. Latham has reported excellent results by the oral method, but his results have not been sufficiently confirmed, and there is experimental evidence to show that tuberculin is rendered inert by the action of the digestive ferments, both pepsin and trypsin. We shall, therefore, confine this description to the subcutaneous method.

The time of day at which the tuberculin should be given is preferably late in the afternoon or evening. Reactions are most apt to appear in from twelve to eighteen hours, and by giving the tuberculin in the evening these can be conveniently watched for and observed on the following day.

The best hypodermic syringe to use is one with a long all-glass cylinder of 1 c. c. capacity, graduated to .01 c. c. The glass part should be sterilized by boiling previous to use, but the needles are best sterilized by alcohol. The required dose having been determined, the bottle containing the proper dilution is selected, the needle plunged through the rubber cap, and the dose withdrawn. For instance, if it is desired to give the patient a dose of .0000007 gm., bottle No. VI, .000001 gm. to 1 c. c., should be chosen and 0.7 c. c. drawn into the needle.

A convenient site for injection is into the subcutaneous tissue of the back between the shoulder blades, alternating from side to side with succeeding doses. The skin at the site can be sufficiently sterilized by rubbing with a pledget of cotton dipped in alcohol.

Records.—Patients should be instructed to take little or no exercise on the day of injection and on the following day. Temperature and pulse records at convenient intervals should be taken on both these days. Careful record should also be made of all symptoms, either of a local or general nature, following the injections. Only in this way can the indication for proper dosage be determined and harmful reactions avoided. With a little instruction most patients can be easily taught to keep their own records in blank books furnished them for the purpose. Specimen pages from a record book used at the Loomis Sanatorium are here reproduced. It was modified and simplified from one devised by Lawrason Brown and published by the *Journal of the Outdoor Life*:

“DIRECTIONS FOR USE

“This record is intended as an aid to your physician in giving you tuberculin. Your symptoms must be his guide as to the proper dose to give; and he will depend largely on this record for a knowledge of those symptoms. Accordingly, accuracy and care in keeping this record are highly essential if you are to derive benefit from tuberculin treatment.

“Each page in this book is intended for the record of one injection. As there are seven columns, one for every day, it will suffice for one week if necessary. If injections are given oftener than once a week, use a new page for each injection.

“The variety of tuberculin and dose will be entered by your physician. The other spaces will be filled in by yourself. Place the proper date at the top of each column, using the first column for the day on which the injection is given.

“Always keep careful temperature and pulse records on day of injection and two following days. If no reaction occurs, they need not be kept longer. In case of a tuberculin reaction keep temperature and pulse records till they have been normal for twenty-four hours.

“Read carefully the list of symptoms. If any of these occur make a

+ mark opposite it in the column headed by the date on which it occurs. If signs or symptoms are not present, leave spaces unmarked. If you have any symptom not in the book, you can make note of it in the blank space left.

"If you have spent the day or part of the day in bed, record it with a + mark. Opposite exercise record the number of hours so spent. Opposite weight record your weight on last weight day.

"If any unusual symptoms occur, or you are in doubt about anything, bring the matter to your physician's attention."

VARIETY OF TUBERCULIN..... No.....

DOSE..... TIME OF DAY GIVEN.....

DATE.....							
TEMPERATURE:							
7:00 A. M.....							
11:00 A. M.....							
4:00 P. M.....							
8:00 P. M.....							
PULSE:							
7:00 A. M.....							
11:00 A. M.....							
4:00 P. M.....							
8:00 P. M.....							
AT PLACE OF INJECTION:							
Pain.....							
Swelling.....							
Redness.....							
SYMPTOMS:							
Headache.....							
Pain in back or limbs.....							
Loss of strength.....							
Sleepiness.....							
Restlessness.....							
Loss of appetite.....							
Indigestion.....							
Nausea.....							
Vomiting.....							
Chilliness.....							
Cough increased.....							
Expectoration increased.....							
Bloody expectoration.....							
Pain in chest.....							
Shortness of breath.....							
Enlarged glands.....							
REST IN BED.....							
EXERCISE.....							
WEIGHT.....							

Dosage.—Modern success with tuberculin as contrasted with the failure in the early days of its use is due partly to the greater care in the selection of cases, but more especially to an increasing knowledge of the necessity of proper dosage and proper interval between doses. In the early days Koch advocated an initial dose of 1 mg. "O. T.," this to be repeated daily and gradually increased, no account being taken of reactions. Comparing this with the present general method of beginning with doses of 1/1,000 mg., or lower, with an interval of at least half a week, one can see the revolution that has taken place in tuberculin therapy. The work of Wright, Denys, and Trudeau has been largely responsible for this change by calling attention to the value of small initial doses.

While practically all agree on the importance of beginning with small doses, there is much difference of opinion concerning the proper increase of dose. In general there are two opposing schools: first, that of Denys, Trudeau, Bandelier and Roepke, Sahli, and most of the German and American therapists, which, using clinical observation as a guide, seeks to carry the patient by gradually increasing doses to as high a degree of tuberculin tolerance as possible; and, second, that of Wright, whose method is to determine the dose which will cause the greatest increase in the opsonic index, and then to repeat that same dose over a long period of time, lowering or raising it from time to time as may be indicated by the opsonic index.

While these two schools include almost all tuberculin therapists, it should be mentioned that there are still a few (Löwenstein, Möller, etc.) who believe that reactions are of value and regulate their dosage accordingly. The method is dangerous and is generally condemned.

It is manifestly desirable that we should have some scientific, accurate, and reliable method for measuring in any given patient the results of a dose of tuberculin and his tolerance. Unfortunately, we have no such method as yet. Wright thought that he had solved the problem by the opsonic index, but the difficulty of technique and the great chance for error in the method have caused it to be discarded by practically all except its originator. Recently White of Pittsburgh (31) has proposed an ingenious method for measuring tolerance to tuberculin founded on the von Pirquet test. The dilution of tuberculin is determined which will produce a skin reaction of given severity, and attempt is made to correlate this with the tolerance to subcutaneous use. The method appears to contain many inherent inaccuracies, but may point the way for future work along similar lines.

Other guides of dosage have been attempted, such as Arneith's neutrophilic blood picture, the agglutination test, the leukocyte count, etc., but their value has never been proven. At present, therefore, we have no accurate scientific guide to tuberculin dosage. Careful clinical ob-

servation of the patient seems to be the safest and most useful guide and is that generally used.

As to the initial dose, while it can be varied somewhat according to the size, strength, and condition of the patient, it is a safe rule to begin with .00000001 gm. of "B. E." or with .0000001 gm. of "B. F." or "O. T." Reaction at these doses will be extremely rare. The interval between doses should not be less than three days, and this only during the first part of the course when the dosage is comparatively low. When the higher doses are reached at least a week should intervene. In fact, it is safer, more convenient, and in many ways preferable, especially when handling a large tuberculin class, to make the interval a week in all cases. One particular afternoon a week can then be set apart for the tuberculin work, to the great convenience of both patient and physician.

No definite rules for increase of dose can be laid down, as the rapidity with which a patient can be brought to tolerate large doses will vary greatly in individual cases. Caution is necessary and the aim should be to avoid reactions. Oftentimes a tuberculin reaction seems to be followed by a hypersensitiveness (perhaps an anaphylactic phenomenon), and it will then be found impossible to work the patient up to any great degree of tolerance. The physician's judgment of the condition of the patient and careful clinical observation of the effect of the injections must be the guide as to the rapidity of increase in dose.

Whether the increase be rapid or slow, it is best that it should be a proportional increase from week to week, and this can be secured by the use of a logarithmic table, such as the one devised by Brown and Pope and here reproduced. By using this table the increase from 0.1 c. c. to 1 c. c. of any solution may be divided into any number of doses from 2 to 12, and the rate of increase will always be proportional.

2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	1	1	1	1	1	1	1
3.2	2.2	1.8	1.6	1.5	1.4	1.3	1.3	1.3	1.2	1.2
10	4.7	3.2	2.5	2.2	2	1.8	1.7	1.6	1.5	1.5
	10	5.6	4	3.2	2.7	2.4	2.2	2	1.8	1.8
		10	6.3	4.7	3.7	3.2	2.8	2.5	2.3	2.2
			10	6.8	5.2	4.2	3.6	3.2	2.9	2.6
				10	7.2	5.6	4.7	4	3.5	3.2
					10	7.5	6	5	4.3	3.8
						10	7.7	6.3	5.3	4.7
							10	8	6.6	5.6
								10	8	6.8
									10	8.3
										10

FIG. 11.—LOGARITHMIC TABLE OF PROGRESSIVE DOSAGE DEVISED BY BROWN AND POPE.

The experience at the Loomis Sanatorium, using "B. E.," has been that it is safe, with most patients, to use the No. 6 rate (which gives about a fifty per cent. increase to each dose) until a dose of .0001 gm. has been reached, and from there on to use the No. 11 rate (about twenty per cent. increase to each dose). If "B. F." or "O. T." is used, it is usually safe to use, during the first part of the course, the No. 4 rate.

If the patient has had a previous course of tuberculin it is safe to begin with a much larger dose and to advance much more rapidly than if on the initial course.

Tuberculin reactions are a contraindication to increasing the dose. If the reaction be a slight one the best plan is to repeat the dose until no reaction takes place, and then cautiously to increase it. If the reaction be more severe it is best to allow an interval of at least two weeks, and then to drop back several doses in the scale. The attempt may then be made to work up again, but at a slower rate of increase. It will often be found that a patient cannot be increased beyond a certain dose without a reaction. In such a case it is advisable to repeat several times the dose just under the one which produces the reaction. If for any reason a patient has missed several injections, it is wise on resuming the course to drop back a few doses below the one which he had previously reached.

Duration of Treatment and Final Dose.—To be of any benefit the duration of the tuberculin course should be at least five or six months. Roughly speaking, from six to twelve months will be the usual duration. Some authorities believe that if given longer than this hypersusceptibility is apt to occur. It is advisable, therefore, to discontinue treatment after nine to twelve months, even if no "cure" has been effected, and then, after a rest of a few months, to begin a second course.

As to the final dose to be striven for, no arbitrary rule can be set. The aim should be to secure in each individual case as high a degree of tuberculin immunity as is possible, remembering that patients differ widely in their tolerance for the drug. Each patient has his own individual limit beyond which it is impracticable to push him and harmful to try to do so. Sometimes it will be found that seeming benefit is derived from the treatment, even though it is never possible to get above the weaker dilutions, but, as a rule, the patients who tolerate large doses are the ones who do best. It will seldom be found possible or desirable to go beyond .005 gm. "B. E." or 1 c. c. "B. F." or "O. T." If these doses have been reached generally it will be wise to repeat them once or twice and then discontinue the course.

Tuberculin Reactions.—These vary in degree all the way from a slight local inflammation at the site of injection to a severe toxemia, indicated by high fever, rapid pulse, prostration, and other constitutional symptoms. A local reaction indicated by induration, redness, and tenderness

about the site of injection is not unusual. If mild this may be disregarded, but if severe it points to caution in increasing the dose.

The constitutional reactions, when they occur, usually begin in from twelve to eighteen hours following the injection, though occasionally delayed longer than this. In addition to the local signs at site of injection, the patient experiences a sense of fatigue and discomfort, often has headache or pains in the back and limbs, usually, though not invariably, accompanied by more or less rise of temperature. There are usually at the same time signs of an increased activity at the focus of the disease, evidenced in the case of the lungs by increased cough and expectoration (fortunately, as a rule, only temporary and diminishing as the reaction subsides). At such a time physical examination may also furnish evidence of this increased activity at the focus. In visible lesions, such as those in the throat or eye, the heightened inflammation can be plainly observed.

The occurrence of a constitutional reaction, even if slight, is a contraindication to increasing the succeeding dose. Until all signs—local or constitutional—of reaction have subsided, the treatment should be discontinued.

The treatment of tuberculin reactions is entirely symptomatic. Ordinarily they subside within one or two days, and require no further treatment than rest in bed until the temperature is normal.

Various theories, which cannot be discussed here, have been advanced to explain the cause of tuberculin reactions. They are probably in some way connected with the phenomena of anaphylaxis and indicate a hypersensitiveness created by a previous contact of the tissues with the toxin of the tubercle bacillus.

At times, although there may be no sharp reactions of any sort, tuberculin intolerance may be indicated by such insidious symptoms as progressive loss of weight, increased cough and expectoration, anorexia, malaise, etc. In such cases it is best to discontinue its use entirely.

Effects of Tuberculin Treatment.—In patients who are able to establish a tolerance to tuberculin considerable amelioration of symptoms is usually noted. Cough and expectoration, which at first may be somewhat increased, tend to diminish. Tubercle bacilli seem to disappear from the sputum more often than in untreated cases.

Tuberculin-treated patients appear to have less tendency to relapse than those not treated. The ultimate effect in prolonging life is believed by Trudeau to be favorable. He has found from his statistics from 18 to 25 per cent. more of patients living after the lapse of from one to fifteen years among his treated than among his untreated cases. Most of these cases were admittedly "selected," however.

Prophylactic Use of Tuberculin.—Tuberculin has been used as a prophylactic measure in individuals suspected of predisposition to tuber-

culosis, but, as there are no accurate means of determining just what individuals have a predisposition, it can be readily imagined that the efficacy of tuberculin for such purpose is difficult of demonstration. Von Behring (3), who believes that practically all tuberculosis is acquired in early childhood through the intestinal tract, has advocated giving tuberculin to all infants as a valuable prophylactic measure against subsequent infection. Little work has yet been done along this line.

Results.—It is a difficult matter to draw any accurate conclusions as to the real value of tuberculin as a therapeutic measure. Statistics as a means of determining such a question are apt to be unreliable. Such statistics as have been published in most instances show a better result in the tuberculin-treated than in the untreated patients. Conclusions from these statistics are misleading, due to the fact that in practically all clinics or sanatoria patients receiving tuberculin are to a certain extent selected cases. The contraindications to tuberculin rule out many cases, and these usually the ones with a bad prognosis. It is obviously unfair, therefore, to compare, as is the usual method, these selected tuberculin-treated cases with the total number of untreated cases.

Sometimes very striking improvement follows the administration of tuberculin, or, on the other hand, the disease may progress unfavorably. To attribute these results, good or bad, to the tuberculin is illogical unless all other factors can be excluded, which from the very nature of a protean disease like tuberculosis is impossible. It is not uncommon to see remarkable changes for the better, even in seemingly hopeless cases, under all varieties of treatment. If such a change takes place coincidentally with tuberculin treatment, the error may naturally be made of attributing it to the treatment.

Another confusing element in estimating results is the fact that almost all the tuberculin cases are at the same time under hygienic treatment. A course of tuberculin treatment occupies several months and the patient must consequently be under observation for a longer period of time than is usually the case in untreated cases. Cannot some of the beneficial results of tuberculin treatment, therefore, be attributed to this fact?

But, in spite of these errors, apt to lead to an overestimation of the value of tuberculin, it seems to be a fact that almost all who have used it extensively feel convinced that it has a definite therapeutic value. This clinical sense of many trained observers appears to be a much more convincing ground for belief in the efficacy of tuberculin therapy than do the unreliable statistics so far published. This feeling of the value of tuberculin cannot be better summed up than in the words of Doctor Trudeau, who has had a larger and a longer experience in this line than anyone else in America: "My belief in tuberculin immunization as favorably influencing the course of chronic tuberculosis rests on no more stable

foundation than a strong clinical impression gained many years ago—an impression which has gradually become a conviction through years of observation. We have much to learn about tuberculin treatment, but even in the present state of our knowledge I am inclined to think that the production of tuberculin immunity by the mild clinical method is capable of favorably influencing the course of chronic tuberculosis, of prolonging life, and in many cases of aborting a commencing infection or extinguishing the smoldering fires of a chronic infection" (28).

SEROTHERAPY

Numerous attempts have been made to produce a passive immunity to tuberculosis by means of antitoxic sera, but without any notable success. The best known of these sera are those of Maragliano and of Marmorek. Both have been given rather extensive trial—sufficient to convince most observers that they have little curative value.

THE THEORY OF AUTOINOCULATION IN TUBERCULOSIS

Regarding tuberculosis as purely a bacterial infection, an invasion of the body by pathogenic organisms, and the elaboration in the tissues and fluids of the body of toxins as the result of their growth and multiplication, the theories of Sir Almroth Wright applied to bacterial infections explain the many and various manifestations of the disease as it is met with clinically. The basic principle of the work of Wright and his collaborators during the past decade is expressed in his own words as follows:

"No one recovers from an acute or chronic bacterial disease unless it be by the production of protective substances in his organism. No one acquires protection against disease except, again, by the production of protective substances; and, finally, no one lives in the presence of infection and repels that infection except by the aid of the protective substances in his blood".

On this theory, if we regard tuberculosis as fundamentally a bacterial infection, it is obvious that prognosis depends upon the capacity of the organism to develop specific protective substances upon those subtle chemical changes in the fluids of the body, which result in the elaboration and circulation of unknown but specific antibodies and which are always the product of the peculiar reaction to the stimuli furnished by the infecting agent itself.

Thus the anatomical lesion as demonstrated by the ordinary methods of examination is altogether of secondary importance; for, while death

may ensue from mechanical causes, as, for instance, from hemoptysis, suffocation, etc., just as in typhoid it may result from perforation of the intestinal wall, this is the exceptional cause, a fatal termination usually resulting from an overwhelming toxemia beyond the capacity of the protective mechanism of the organism to combat.

The acute or active stages of the disease may then be explained by entrance into the circulating blood of overdoses of toxins manufactured at the seat of the infection, before and until the protective mechanism of the body has developed sufficient antibodies to neutralize their effects; and subsequently in favorable cases the subsidence of acute manifestations and the return to an appearance of normal health are explained by the presence in the blood of sufficient neutralizing agents, as a result of the stimulating action of the toxins, to offset and "bind" the latter. And, finally, convalescence is established when the protective mechanism has elaborated sufficient antibodies to produce an immunity and destroy the infecting microbes, all this irrespective of the character, extent, or location of the anatomical lesion.

A lesion so small as to be undemonstrable by ordinary methods of examination may develop and throw into the circulating blood enough specific poison to produce all the symptoms of an acute progressive tuberculosis and prostrate the patient, while, again, an extensive lesion involving both lungs and with considerable cavitation is often associated with every outward appearance of health and a sense of robust well-being.

In the former case, according to Wright's theories, the patient is suffering from excessive inoculations derived from the seat of the infection, to which his organism is incapable of opposing sufficient antibodies—excessive autoinoculation. In the latter case one of two conditions has arisen: Either the response to the stimulation has resulted in the production of sufficient protective substances to neutralize the toxins, or the lesions have become so walled off by impervious connective tissue formation as to prevent autoinoculation; i. e., entrance of toxins into the general circulation in sufficient doses to do damage.

The Control of Autoinoculation.—It has been found by long experience that patients suffering from acute manifestations of tuberculosis are much improved and their symptoms brought under control, in many cases, by rest in bed, that, having attained a normal temperature and other evidences of betterment, they may, if prematurely allowed to get up and move about, quickly relapse with a return of the acute symptoms which characterized the former attack. Again, it has been found that patients evidently progressing favorably and without active symptoms on limited exercise may very readily develop "renewed activity" with acute symptoms, following a sudden considerable increase of exercise.

These phenomena are very instructive and have led to the recogni-

tion of the principle of "controlled autoinoculation," i. e., using the patient's own organism for the elaboration in the body of bacteriotrophic substances for the production of a specific immunity to the infection from which he is suffering.

It has been found that by a careful regulation of rest and exercise autoinoculation in a large number of cases may be very accurately measured and controlled, and in the cases in which this is possible it may be employed to inestimable advantage in treatment. It has further been found that, when autoinoculation cannot be controlled, a fatal termination is inevitable.

It has long been recognized and has formed the basis of modern treatment of tuberculosis that, during the active symptoms of the disease, the patient should be kept at rest. With the subsidence of fever and other manifestations of an active process, more or less exercise, according to circumstances, may be permitted, and in the practice of a few therapeutists possessing the courage of their convictions exercise has been gradually increased to a point representing a reasonably hard day's manual labor. Otto Walther at Nordrach, for instance, who utilized walking exercise almost exclusively, frequently brought his patients up to twenty or more miles a day, through a carefully graduated increase from day to day. He found that such patients as could reach the higher grades of exercise improved much more rapidly and permanently than those who remained at rest or on very limited exercise, and were much better prepared to return to a self-supporting occupation after discharge.

In many institutions, both in this country and abroad, and in some instances in private and dispensary practice, a similar plan was followed, with, of course, individual modifications of one kind and another. It was popularly understood as a "hardening process." It served to keep patients busy, to occupy their time and their mind, to keep them from laying on useless adipose tissue, and to stimulate their appetite.

In a few institutions exercise was diverted into forms of useful manual labor, possessing to some extent an economic value.

But a satisfactory scientific explanation of the real value of exercise was not offered until Marcus Paterson of Brompton Hospital Sanatorium at Frimley, England, applying Wright's principle of autoinoculation, with the assistance of Dr. A. C. Inman, discovered that there was a definite relationship between autoinoculation induced by exercise (manual labor) and the condition of the patient as shown by the opsonic index, body temperature, weight, and the character and amount of the sputa. Furthermore, that a reliable control of the autoinoculation was possible therapeutically by a system of graduated exercise (labor). All of the advantages formerly recognized as the result of exercise in the treatment of tuberculosis could thus be explained on the theory of active immunization effected by the introduction into the circulation of slowly increasing

doses of toxin derived from the focus of infection and elaborated in the patient's own body.

Acting upon this principle, Paterson has developed an admirable system of graduated labor at Frimley, from which he has attained excellent clinical results. Wherever it has been adopted in other institutions, it has met with success exactly according to the strict adherence to the principles upon which the whole scheme is based.

If exercise or labor be introduced into the treatment of tuberculosis merely as a *diversion* for the patient, as a "hardening process," as a means of stimulating the appetite or promoting a healthy state of mind and digestion, or, worse still, as an economic factor, without the vitally important comprehension of its dominant function, i. e., the production of autoinoculations of specific poisons, then the system is almost surely doomed to failure. But, when the fundamental principle of its action is kept conspicuously in view, its therapeutic value has been repeatedly demonstrated, and without doubt it forms one of the most potent factors in the therapeutics of tuberculosis.

If any plan of graduated exercise be adopted, and it is doubtful if any such plan can be carried out to best advantage outside a sanatorium, it is of the first importance to recognize promptly the symptoms of an "overdose," an excessive autoinoculation. Paterson has shown that the effects of treatment may be very accurately gauged by its influence upon:

- (a) The temperature,
- (b) The sputum,
- (c) The patient's feelings,
- (d) The appetite,
- (e) The weight,

quite similarly, in fact, to the guiding signals in tuberculin treatment. The opsonic index may also be employed, but, owing to the experience and the time required to make index determinations, it is not a practicable method for ordinary clinical use, and, as the other methods are sufficiently accurate and always immediately available, it is quite unnecessary.

A patient upon increasing exercise should be under *constant supervision*, and should be familiarized with the danger signals of an "overdose." A failing appetite, a sense of malaise, or loss of weight when the latter is not above normal are significant symptoms, frequently appearing before the temperature rise and increase of sputum. They are indications for a reduction in the amount of exercise, though not necessarily for a return to "absolute" rest. A rise of temperature which does not fall to normal with thirty minutes' rest and a marked increase of sputum, or a distinct change in its character toward purulency, with an increase

of cough, are more imperative signals and indicate *rest*, more or less complete according to the degree of the symptoms.

Paterson considers a mouth temperature of 99 degrees or more, if attended by headache or malaise, an indication for "absolute" rest.

(The effect of exercise upon temperature, with especial reference to the physiological rise during and immediately following muscular exercise, has been discussed in another section of this article.)

It is the experience, in this country at least, that headache and a sense of malaise may be entirely absent with a temperature which clearly calls for rest, so that a patient's subjective symptoms by themselves do not form a safe and sufficient guide to treatment. Temperature, therefore, should be very carefully watched during the periods of increase in the exercise. For the purpose of accurate supervision a daily chart should be kept in all cases until the patient has reached the maximum grade, such a record having reference particularly to the points mentioned.

The relation of hemoptysis to exercise is a question which has been by no means settled. It is comparatively rare that hemorrhage occurs during or immediately following exercise; it usually makes its appearance in ambulant cases during the night or early morning while the patient is at rest, and when the blood pressure, as read by the sphygmomanometer, is lowest. No wholly satisfactory explanation has been advanced for this fact, although the theory is plausible that during exercise the muscular blood supply is considerably increased, and, with the consequent rise in peripheral pressure, the strain is taken off the visceral vessels, while during sleep the opposite condition obtains, with a considerable increase of pressure in the vessels of the pulmonary circulation. Be this as it may, it has for long been the practice to place the patient on "absolute" rest in the presence of hemoptysis, and this is no doubt a wise procedure. However, experience teaches that in most cases blood-stained or slightly discolored sputum, in the absence of other symptoms, may be safely disregarded and need not of itself interrupt the course of treatment by induced autoinoculation.

Whatever plan of exercise be adopted, whether walking, manual labor, or systematic gymnastics, it is very necessary that it should be carefully graduated. The Frimley scheme as worked out by Paterson is interesting for its completeness and attention to detail. It probably admits of a more accurate control of exercise than any other which has been devised, although, unfortunately, it is not practical of application to all classes.

He divides the course into six grades, differing slightly as to sex, and after the preliminary walking tests uses manual labor in lieu of other exercise. The scheme is shown in the following tables:

TUBERCULOSIS

*TABLE I—MEN'S WORK

COURSE OF TREATMENT	PERIOD	WORK PERFORMED
WALKING	One to Four Weeks Resting when not walking	Beginning at half a mile per day—1 "round." Rising to 1, 2, 4, and 6 miles per day, equal to 2, 4, 8, and 12 "rounds" per day. Half the number of "rounds" to be completed in the morning and the other half in the afternoon.
GRADUATED LABOR; GRADE 1	One Week 9:55 A. M. to 11:50 A. M.; 2:30 P. M. to 4:50 P. M.; rest 12 to 12:45 P. M.	<i>Small Baskets.</i> —A weight of about 10 lb. is carried a distance of about 50 yds.; total weight carried, about 8.5 cwt.; distance traveled to and fro, about 7 miles. <i>Equiv- alent work:</i> Light weeding, potting, prick- ing out seedlings, picking off dead flowers, watering plants (using 1-gallon can), etc., painting with "sash tool."
GRADE 2	One Week Time same as above	<i>Large Baskets.</i> —A weight of about 18 lb. is carried a distance of about 50 yds.; total weight carried about 15 cwt.; distance traveled to and fro, about 7 miles. <i>Equiv- alent work:</i> Weeding with hand fork, plant- ing out in open ground, cutting vegetables, watering plants with two 1-gallon cans, or one two-gallon can, etc.
GRADE 3	One Week Time same as above	Sweeping paths and grass, cutting grass edges, chopping firewood, hoeing, painting with large brush, cleaning windows, etc.
GRADE 4	Two Weeks Time same as above	Using a small shovel or digging with a small fork. Five men can pull hand-cart contain- ing soil or stones. Mowing grass, 3 men to 16-in. mower. Two tons of earth can be raised 7 feet in this grade. Three men to a roller weighing 4.75 cwt. Using mortice chisel and tenon saw, etc.
GRADE 5	Three Weeks Time same as above	Using large shovel and pick: digging with large fork. Pulling down trees and trench- ing ground 3 feet deep, hauling stones, etc., in cart, using wheelbarrow, doing general heavy navvy work. Six tons of earth can be raised 7 feet, or 10 tons of concrete mixed. Sawing. Planing.
GRADE 6	Three Weeks 10 A. M. to 12:45 P. M.; 2:30 P. M. to 4:50 P. M. "Off Rest"	Work similar to Grade 5, except that rest from 12 to 12:45 is omitted.

* Marcus Paterson—Autoinoculation in Pulmonary Tuberculosis. James Nisbet & Co., London, 1911.

TABLE II—WOMEN'S WORK

COURSE OF TREATMENT	PERIOD	WORK PERFORMED
WALKING	One to Four Weeks Rest 12 to 12:45, with extra rest if necessary	Beginning at half a mile per day—1 "round." Rising to 1, 2, 4, and 6 miles per day, equal to 2, 4, 8, and 12 "rounds" per day. Half the number of "rounds" to be completed in the morning and the other half in the afternoon.
GRADUATED LABOR; GRADE 1	One Week 9:55 A. M. to 11:50 A. M.; 2:30 P. M. to 4:50 P. M.; rest 12 to 12:45	<i>Small Baskets.</i> —A weight of 8 lb. is carried a distance of about 50 yds.; total weight carried, about 7 cwt.; distance traveled to and fro, about 5 miles. <i>Equivalent work:</i> Preparing vegetables, light table work, watering, weeding, cleaning feeding-troughs for chickens, putting bracken in nests and setting same.
GRADE 2	One Week Time same as above	<i>Large Baskets.</i> —A weight of 15 lb. is carried a distance of about 50 yds.; total weight carried, about 14 cwt.; distance traveled to and fro, 5 miles. <i>Equivalent work:</i> In garden similar to that given for men; chopping suet; filling water dishes for chickens, also hoppers for grit and oyster shell.
GRADE 3	One Week Time same as above	Sweeping paths and light gardening. Scrubbing hen nests. Cleaning out small chicken houses every morning.
GRADE 4	Two Weeks Time same as above	Digging with small fork, turning over soil. Whitewashing large chicken-houses; changing mold and gravel as necessary. Preparing food for chickens, but not mincing it.
GRADE 5	Three Weeks Time same as above	Scrubbing. Trenching ground, using 3-lb. pick and small shovel; sifting sand. Mincing food and cutting bones for chickens.
GRADE 6	Three Weeks 10 A. M. to 12:45 P. M.; 2:30 P. M. to 4:50 P. M. "Off Rest"	Work similar to Grade 5, except that rest from 12 to 12:45 is omitted.

That exercise thus diverted into channels of useful labor has an economic value is a mere incident. A twofold object is in view: (a) to introduce into the patient's circulation therapeutic doses of toxins manufactured at the seat of his own lesion, and theoretically more potent because autogenous, and (b) to prepare him in the most efficient way to resume his occupation after discharge from treatment. All other considerations are secondary.



FIG. 12.—ARTIFICIALLY INDUCED AND CONTROLLED AUTOINOCULATION BY MEANS OF GRADUATED LABOR. Men patients at Annex of Loomis Sanatorium at work road building, corresponding to Paterson's Grades 5 and 6, from four to seven hours daily.

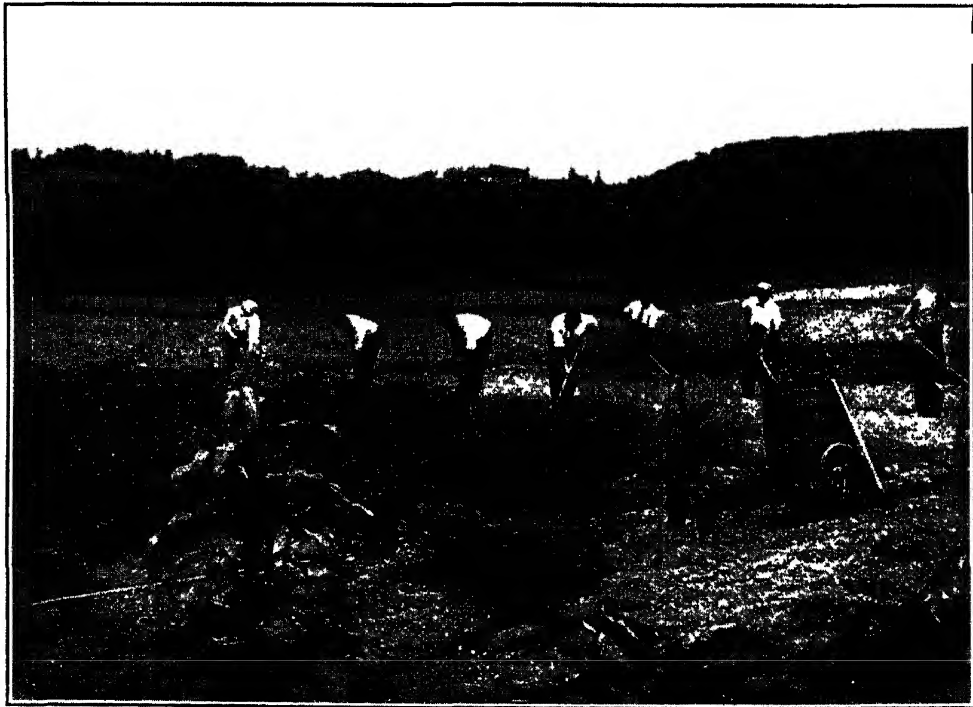


FIG. 13.—ARTIFICIALLY INDUCED AND CONTROLLED AUTOINOCULATION BY MEANS OF GRADUATED LABOR. Men patients at Annex of Loomis Sanatorium on a grade corresponding to Paterson's Grade 3.



FIG. 14.—ARTIFICIALLY INDUCED AND CONTROLLED AUTOINOCULATION BY MEANS OF GRADUATED LABOR. Men patients at Brompton Hospital Sanatorium, Frimley, England, working on Grade 5, excavating for reservoir. (Courtesy of Marcus Paterson, M. D.)



FIG. 15.—ARTIFICIALLY INDUCED AND CONTROLLED AUTOINOCULATION BY MEANS OF GRADUATED LABOR. Women patients, at Brompton Hospital Sanatorium, Frimley, England, working on Grades 3 and 5. (Courtesy of Marcus Paterson, M. D.)

As a matter of fact, such work as patients do while under treatment is of very doubtful economic value. It is not always an easy matter to devise suitable labor for patients, and the time and experience necessitated by the supervision, which is indispensable, usually offset any profit which might otherwise accrue to the institution in which such a plan of treatment is carried out.

But its therapeutic value is indisputable, and its psychological aspect is not to be despised. A patient of unusual intelligence and of a certain temperament may bring his walking exercise up to twenty miles a day or spend his allotted time in selected gymnastic exercise and be content



FIG. 16.—ARTIFICIALLY INDUCED AND CONTROLLED AUTOINOCULATION BY MEANS OF GRADUATED LABOR. Women patients at the Annex of Loomis Sanatorium—graded according to time.

to note the improvement in his physical condition as a reward for his labor; but the average person likes to have some *tangible* result from the expenditure of his energy. Even if it is nothing more than a hole in the ground or a pile of kindling wood, he will the more cheerfully go to work the next day and derive a sense of satisfaction in the growth of the woodpile or the widening of the excavation.

The illustrations show men and women at work on varying grades of exercise at Frimley, and at the annex of Loomis Sanatorium, where a similar plan of treatment is carried out among selected groups of patients.

The results are extremely gratifying in both cases, although, as has been said, the plan as here described and illustrated has a somewhat limited scope.

The principle, however, is one capable of general application and should be employed in one way or another in the treatment of all classes of patients where physical conditions will permit.

Fresh air and a generous, well-balanced diet are very important, and even essential, elements in the treatment of tuberculosis, but the sooner it is recognized that alone they do not and can not cure the disease the better it will be for that large group of individuals who suffer from tuberculosis, the care and treatment of whom is quite as much a social and economic problem as it is one of medicine.

ARTIFICIAL PNEUMOTHORAX

The idea of creating a pneumothorax as a therapeutic measure in pulmonary tuberculosis is not a new one. As far back as 1833 Morton of Philadelphia says of it (19):

“The disposition of the lung to collapse on itself in cases of abscess has led some authors to suggest the propriety of inducing this condition by artificial means, viz., by making an opening through the intercostal muscles. The lung would, of course, collapse, provided no adhesions existed; but the presence of these would preclude all advantages from the operation; and, again, if in place of simple abscess the lung should be full of tubercles, the event would be yet more hopeless. It is obviously one of the most unpromising expedients that human ingenuity has yet devised in this disease; nor should I have noticed it here *had it not absolutely been put in practice.*”

In 1882 Forlanini of Pavia revived the method and tried it with some degree of success on a number of patients, injecting nitrogen through a hollow needle into the pleural cavity. Murphy of Chicago in 1898 advocated and practiced a similar method, and some years later Brauer in Germany devised the “open” method, making an incision through the chest wall down to the pleura, and then injecting gas. During the past few years both methods have been tried rather extensively, especially in Germany, and have met with considerable success.

The object of the method is to put at rest, to “splint,” as it were, the diseased lung, to collapse any cavities present, and to force out collected secretions. It has been tried, for the most part, only on ad-

vanced cases, or those not progressing favorably under ordinary treatment. Very probably early cases might be favorably influenced by it also, but, as the measure is a comparatively heroic one, and not altogether devoid of danger, it would seem wiser in the present state of our knowledge to reserve it for cases which have failed under hygienic treatment.

In the selection of cases the following rules should be observed:

1. Only unilateral cases, or those with slight inactive involvement on the sound side, should be given the treatment, since the method necessarily throws extra work on the lung on the uninflated side.

2. Extensive pleural adhesions, especially at the base, make the injection of gas impossible. Partial or slight adhesions may yield to the

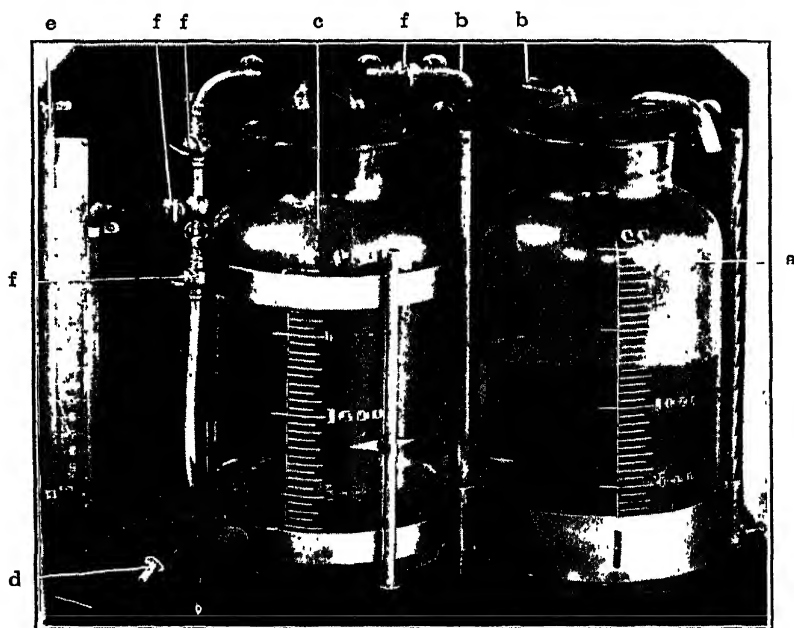


FIG. 17.—DOCTOR SAMUEL ROBINSON'S APPARATUS FOR THE PRODUCTION OF ARTIFICIAL PNEUMOTHORAX.

pressure of the gas. It is often impossible to determine beforehand whether pleural adhesions are present; therefore, in doubtful cases, if suitable otherwise, attempt at inflation should be made.

3. Cavity cases with much expectoration, with or without fever, if conforming to the above requirements, offer the best indication for the trial of the method. Some truly marvelous results in the clearing up of such cases have been observed.

4. Severe hemorrhages have been successfully controlled by producing a pneumothorax. It is unwise to use it for this purpose except

as a last resource, on account of the obvious difficulty of determining from which side the bleeding comes.

Many types of apparatus for injecting the gas have been devised. The accompanying illustration is of the apparatus devised and used by Dr. Samuel Robinson of Boston, and is the one used at the Loomis Sanatorium. The essential features are pressure bottle (a) filled with sterile water or pyrogallie acid solution, which flows through siphon (b) into gas bottle (c), forcing the gas contained in the latter through tube (d), to end of which is connected the injecting needle. Connected with tube (d) is a water manometer (e), by means of which can be read the pressure changes occurring in the pleural cavity. Stopcocks at (f) control the flow of gas and allow the manometer to be connected or shut off. Bottle (a) can be raised or lowered, so varying the pressure under which the gas is forced into the pleural sac. The graduation on bottle (c) allows the amount of gas injected to be measured.

Nitrogen gas, if obtainable, is preferable, on account of the slowness of its absorption. Atmospheric air, however, may be used, though reinjection must be made at more frequent intervals.

The site of injection is preferably the axilla, in the 7th or 8th intercostal space, but, if adhesions are present at this point, one farther backward or forward should be tried. The immediate neighborhood of cavities should be avoided. A preliminary injection of novocain, 1 per cent., along the route of the needle and extending into the pleural cavity should be made. Shock from pleural reflex is much less likely when local anesthesia is used. The needle should be inserted with the gas entirely shut off. As soon as the needle enters the pleural sac a negative pressure will be recorded on the manometer, and oscillations of several centimeters in the height of the fluid in the manometer will occur with each inspiration. Until these characteristic oscillations are obtained, the rule should be made absolute that no gas be injected. By following this rule the dangers of gas embolism in the veins, of surgical emphysema, or of injecting the lung are avoided. When satisfied by the manometer readings that the point of the needle is in the pleural cavity, the manometer should be shut off and gas allowed to flow in slowly. After every 200 c. c., or oftener if deemed advisable, the gas should be shut off and a manometer reading made. As soon as a positive pressure is obtained, the injection should be stopped. The amount to be injected at the first operation varies. If the patient experiences no marked discomfort and the pressure does not become positive, from 300 to 700 c. c. may be injected. On reinjection greater and greater amounts may be used until a complete collapse of the lung is obtained.

Reinjections should be made at frequent enough intervals to offset absorption of the gas and expansion of the lung. This can be best determined by careful daily physical examination. Ordinarily the injections

will have to be repeated every three or four days at first, but later much longer intervals will be sufficient. The length of time during which the treatment should be continued should be determined largely by the patient's condition and by the amount of benefit derived. Usually from two to eight months will be long enough, but in some patients the collapse has been maintained for as much as two years, with subsequent reëxpansion.

Valuable recent articles on the subject are those by Lillingston (17 and 18), and of Robinson and Floyd of Boston (22 and 23). See also References 2, 6, 7, 9, 10, 11, 13, 16, 21, 29, 33.

DIET

The problem of nourishment in the treatment of tuberculosis, especially when any considerable group of patients is to be considered, as in a sanatorium, is at best a difficult one. This is particularly true in America, where not only individual tastes differ so widely, but where there are commonly brought together patients of various nationalities, each with its peculiar dietetic habits and prejudices, and, with hardly less marked differences, patients from the many widely separated sections of our own country. Add to this the undeniable fact that the act of preparing, cooking, and serving food is far from being highly developed in America, and the difficulties incident to feeding a more or less large group of invalids of this class over a protracted period of time become apparent.

During the active stages of the disease appetite is capricious, as a rule, and constant watchfulness must be exercised almost as often to prevent harmful excesses as to encourage a diet sufficient to meet the requirements.

Hyperalimentation as advocated and practiced a few years ago in a "stuffing process" has been abandoned by physicians experienced in the treatment of tuberculosis, but the tradition lingers persistently in the lay mind, and, left to his own discretion, the average patient is obsessed with the idea that he must not only eat to the point of repletion on the occasion of each regular meal, but, regardless of physiological requirements, add to his diet as many raw eggs and as much milk and cream between meals as his stomach will tolerate. That such a system of forced nutrition is not only of no benefit but actually harmful has been repeatedly demonstrated; but that it is one which is still common even among otherwise quite intelligent people is a matter of constant observation.

During the more acute phases of the disease the patient, if left to his own initiative, will seldom overeat. Loss of appetite, anorexia, and gastric disturbance characterize active tuberculosis, and these symptoms, associated as they are with a general inhibition of nutrition, are frequently a stumbling block to dietetic treatment. Likewise, in slowly progressive, apyretic tuberculosis of long standing, the desire for food is so lack-

ing that the efforts of the physician must be directed toward urging a sufficient amount rather than otherwise. It is at the beginning of convalescence, when there has become established a more or less well-marked immunity to the toxins of the disease, that the danger of overeating is a practical one. A returning appetite and an increasing digestive capacity, marking as they do the beginning of convalescence, are naturally welcomed by the patient, his family, and the physician as such favorable symptoms that to guard against overindulgence does not at first occur to one, nor is it easy to realize that an excess in the amount of food is being taken until it is either actually or approximately measured. Frequently attention is first called to the matter by phenomenal weight gains, and even then there is a very natural disposition to look with satisfaction rather than suspicion on what should really be taken as a warning. Emaciation is a characteristic symptom of tuberculosis, to combat which every effort should be made to improve nutrition, and to introduce into the body a sufficient amount and a well-balanced ration; but it must be borne in mind that nourishment depends upon assimilation, and that so long as the disease is actively progressive the ingestion of even large quantities of food will fail to help matters to any appreciable extent, and if given to excess only impose an additional burden upon the organs of elimination already overtaxed. A small, well-proportioned diet adapted to the individual will at such times do more for the patient than can possibly be expected from a diet which is in excess of his enfeebled powers of assimilation.

A suitable diet for a patient without fever and progressing favorably in the absence of complications does not differ materially either in quantity or quality from a suitable diet for the same person in health—with this exception, however, that in the case of a tuberculous invalid much under weight a somewhat more generous ration is indicated than would be required for a healthy person taking a like amount of exercise. Increase in exercise both in health and in the presence of a tuberculous lesion demands a corresponding increase in food according to well known physiological laws. Generally speaking, this demand is indicated by an increased appetite and a greater relish for the proteid elements of the diet, particularly for the proteids of animal origin. The same phenomenon occurs in a patient recovering from a protracted and wasting acute stage of tuberculosis, even before exercise has been prescribed, and, as has been pointed out, is one of the first indications of a developing immunity to the toxemia on the part of the organism.

The actual food requirements in any individual case can, with a little pains and experimentation, be worked out satisfactorily, but, as individuals differ in their food requirements within such wide limits, it is not practicable to apply any dietetic standard to an individual case without first determining the actual conditions which govern the particular case.

Observation over a considerable period of time and in a large number of cases shows that the *average* food requirements differ very little under like conditions. The same is true as to the diet constituency, although this differs somewhat in different countries owing to long established national dietetic habits. For instance, in Germany, according to Voit, Rubner, and others, a considerably larger proportion of carbohydrates and a correspondingly smaller proportion of fats are consumed by the average person in health than is the case either in England or America. In the latter especially fats form a much larger part of the ration of the average person. There is less difference in the *average* protein constituency of the diet in different countries, although the source of the protein is more variable.

But, while *averages* are so similar, individuals present marked differences in their requirements, as has been said, and often without any apparent cause. It is a matter of common experience to see certain patients improve in all respects and regain or pass their normal weight upon a diet which will be quite inadequate to maintain weight and improvement in other patients, to all appearances of the same class and in the same condition. It is, therefore, quite out of the question to lay down rules which shall govern the amount of food or even its constituent proportions, and expect such rules to be generally applicable to individuals irrespectively. The problem must be worked out in each case and studied carefully in order to obtain the best results.

The following general rules, however, as the result of several years' observation, have proven of value to the author in arranging dietaries for various classes of tuberculous invalids:

(a) Men of the same respective age and weight seem to require a larger diet than do women.

(b) All other conditions equal, a larger diet is apparently required by persons under thirty years of age than is the case after that period.

(c) The laboring classes, i. e., those who earn their living by muscular work, require more food than is the case with those living a more sedentary life, and in a certain measure the dietetic habits necessitated in the first place by occupation persist after occupation distinctions are removed.

(d) The urban dweller consumes a larger relative amount of animal food and therefore derives a larger percentage of his energy from the protein constituent of his diet than is the case with the country dweller. This, of course, applies only to the higher orders of civilization.

With these points in view and bearing in mind the wide individual variations which occur in all classes, we may assume for present purposes the following standards, applicable to ambulant cases of comparatively quiescent tuberculosis under sanatorium treatment:

(1) For the young adult men of the "working class" on very light exercise from 2,800 to 3,200 calories, of which from 110 grams to 125 grams shall be protein.

(2) For the same class on five or six hours' vigorous exercise (sawing or chopping wood, working with shovels, pickaxes, barrows, etc.), from 3,100 to 3,600 calories, of which 125 grams to 140 grams shall be protein.

(3) For women of this class 200 calories and approximately ten grams protein may be deducted in each case.

(4) For young adult men whose occupation has been more sedentary, e. g., clerks, bookkeepers, tailors, students, etc., on moderate exercise (walking from one to three hours daily), 2,600 to 3,000 calories, of which not over 115 grams need be protein.

(5) For women of this class not to exceed 2,500 calories and 100 grams protein.

(6) For older patients a slight reduction in calorific value and a considerably lower protein constituent are desirable in each case.

(7) For the country dweller a somewhat larger bulk, without increase in protein value, is usually desirable, all other conditions being similar, than is the case with the patient from the city (12).

As has been said, individual variations are marked. Occasionally patients have been known to do well and gain weight on a diet as low as 1,800 calories with only eighty or ninety grams protein. More rarely others thrive, without digestive disturbance or other evidence of overeating, on a diet as high as 4,000 calories over a considerable period of time. In the latter case the increase is chiefly in fats and carbohydrates. Such a diet in any patient on restricted exercise, especially if there be a proportionate increase in proteids, is almost certain to work mischief eventually, and in the great majority of cases should be regarded as excessive. A patient who in normal life is accustomed to hard manual labor and a correspondingly large diet will, of course, more easily accommodate himself to such a diet (a return to his accustomed amount of food) as convalescence proceeds and his exercise is increased than is the case with patients whose former occupations have been more sedentary and whose diet has corresponded. In the former class nothing is to be feared from a ration which would almost certainly prove excessive in the latter, even while both are on the same allotment of exercise.

On the whole, however, the somewhat flexible standards given above are quite generally applicable and have proven safe as working bases over several years and with large groups of patients. They correspond closely with the standards worked out by Bardswell and Chapman in England, and do not differ materially from those which have been found satisfactory for healthy communities both in England and America.

They apply, of course, to that large class of tuberculous patients which is ambulant and free from serious complications, which in fact does not differ essentially, so far as diet is concerned, from the same group in health. The special dietetic requirements of the far advanced, acute, and seriously complicated class of tuberculous invalids will be considered separately. Having determined, then, approximately the amount and chemical constituency of a suitable diet, it remains to so construct it that it shall satisfy the taste and not exceed the purse of the patient, and it is here that the ingenuity of the dietitian or the physician is brought to the test. It is one thing to prescribe a suitable diet in terms of proteids, fats, and carbohydrates, and quite another to construct such a diet in a manner to satisfactorily meet the individual requirements.

In the case of the well-to-do efficiency alone need be considered, and this is comparatively easy to secure when the matter of cost can be ignored. Indeed, with a competent cook and a good market, the matter can be left largely to the tastes of the patient and the judgment of the cook, with but an occasionally exercised oversight on the part of the physician. But in institutions, either charitable or semicharitable, and in the case of patients among the poorer classes in private or dispensary practice, economy must be combined with efficiency, and here the problem is more difficult.

It is a commonly observed fact that among the poorer classes of wage earners there is a relatively extravagant table with a comparatively deficient nutritive value. This is due to a lack of judgment in the selection of material and skill in its preparation. The cheaper cuts of meat and all vegetables require skill, experience, and some talent in their preparation for the table, if their full nutritive value is to be secured, and if they are to be presented in a form most attractive to the palate. The more expensive cuts of meat require much less skill and time on the part of the cook. The housewife in the families of the poor, as a rule, lacks not only the necessary skill, but has too little time, aside from her other manifold and arduous duties, to make herself proficient in the culinary art. As a consequence she selects such foodstuffs as require the least time and skill in preparation, and in so doing increases the cost of the ration. Thus it comes about that, when tuberculosis develops among this class, the physician, conscious of the difficulties in the way of prescribing a mixed diet which shall meet the requirements, is almost forced to prescribe eggs and milk in quantities sufficient to make up the necessary calories. Undoubtedly a well-balanced mixed diet, properly prepared, would be much more efficient, and, with intelligent buying, much less expensive. It is true that milk possesses in itself all of the nutriment necessary to the support of life in man, and in infancy and early childhood is the ideal diet. Moreover, when reinforced by eggs, it con-

stitutes a food which will suffice for the adult, but it is by no means a satisfactory ration for the adult even when so reinforced, and if persisted in it will work serious mischief with the functions of digestion, and make a return to a normal diet a difficult matter.

In the families of the poor, however, and among tuberculous invalids of all classes, in certain stages of the disease, milk or raw eggs or both constitute the most ready and effective means of reinforcing an otherwise deficient dietary. Used with judgment and discretion, and bearing in mind that a return to a normal mixed diet, as soon as it is possible to do so, is a most important desideratum, milk and eggs may properly be considered the chief auxiliaries to diet in tuberculosis.

Sources of Food Supply.—The protein in a normal mixed diet for a man on moderate exercise constitutes about one-sixth of his total food energy as estimated in calories—e. g.:

Protein	125 grams=	500 calories
Fats	125 grams=	1,125 calories
Carbohydrates	400 grams=	1,600 calories
<hr/>		
Total, 3,225 calories		

Analysis of a large number of individual diets approximating such relative proportions and total amount of food shows that on an average about 75 per cent. of the protein is derived from animal sources and 25 per cent. from vegetable sources. When starch digestion becomes impaired, as is frequently the case in tuberculosis during the stages when exercise is much restricted, there is usually a falling off in the amount of carbohydrates consumed out of proportion to the total lowering of the diet. In such cases a larger percentage of protein is derived from animal sources, while, of course, among many individuals habit and taste modify the relative proportions in both directions. But on the average the relation will be found to approximate 75 to 25 very consistently, in this country at least.

Butchers' meat furnishes about twenty to twenty-five per cent. only of the total protein in an average mixed diet. Where milk and eggs are regularly taken with the meals, they supply the larger part of the remaining protein to be accounted for as derived from animal sources. In America, except in the coast fishing towns, sea food comprises an insignificant article of diet—a fact which is to be deplored, since, if it is properly prepared, fish is a most wholesome and inexpensive article of food.

Of the protein derived from vegetable sources in a mixed diet, such as that described, the great part is supplied in bread, cereals, and puddings. The fats of such a diet are derived chiefly from butter (or its

equivalent), cream, meat fat, either in the meat as served or as used in the preparation of other foodstuffs, and eggs. "Drippings" and margarine as substitutes for butter have almost the same nutritive value as the latter, and in the construction of an inexpensive diet are employed in some sections of this country and somewhat more extensively in England.

The carbohydrate portion of the diet is, of course, derived almost entirely from vegetable sources, although when considerable quantities of milk are taken it furnishes an appreciable amount of this constituent. Cane sugar is almost a pure carbohydrate, and can be reckoned gram for gram. Bread, cereals, the legumes, and other vegetables constitute the great bulk of this important constituent of the diet.

More than one-half the total calories of a normal and well-balanced ration should be supplied in the carbohydrates. It is, therefore, important that vegetables, from which the greater part of this constituent of the diet is derived, should be selected with judgment and carefully prepared and cooked. It is quite as much an art to properly prepare vegetables for the table as it is in the case of meat and fish. As commonly served in hotels, boarding houses, institutions, and even in private families, they are usually unattractive to the taste and often indigestible, and for this reason the carbohydrate content of the diet is often found to fall below the standard of highest efficiency.

In many of the diet "cures," which have been so highly developed in Europe, particularly in Germany and Switzerland, the ingenious preparation of vegetables and the skillful combination of varieties make it possible to raise the amount of carbohydrates to constitute three-fourths or more of the total calories required, thus permitting a corresponding lowering of the proteins, and still to maintain a highly palatable and very efficient diet.

In the dietetic treatment of tuberculosis too little attention has been given to the value of carbohydrates, and too much stress laid upon the proteins and fats.

Preparation of the Food.—The physician who essays to treat tuberculosis should not consider it beneath his dignity to acquire some knowledge (theoretical at least) of the culinary art. He will do well, in fact, to familiarize himself with the various cuts of meat, their relative cost and nutritive value, and to know how they should be prepared and cooked. No less should he be competent to supervise the cooking of vegetables.

The most choice and expensive cuts of meat may be rendered insipid to the taste and greatly reduced in nutritive value by ignorance or carelessness in cooking. The same is true of poultry.

Meat or poultry roasted at a moderate even temperature and not properly basted will come out of the oven dry, tough, and tasteless, with the result that it fails to appeal to the appetite, not to speak of the actual loss of substance which it suffers. To properly roast or boil meat or

poultry it should be subjected first to a high degree of temperature—e. g., 400° to 500° F. in the case of roasting, or to boiling water in the case of boiling—such a heat as will insure the quick formation of a “crust” on the surface, which prevents the juices from escaping and thus not only retains the flavor but the tenderness of the meat.

As soon as this is accomplished, which in fact requires but a few minutes, the temperature should be reduced to not above 190° F., where it should be maintained until the joint or the fowl, as the case may be, is thoroughly cooked. This requires from thirty-five to forty minutes per kilogram (seventeen to twenty minutes per pound) of the meat to be cooked. In the case of roasting it is best to use a skewer over a dripping pan, and it is very desirable to see that the joint or the fowl is frequently basted during the process. Skillful cooks accomplish this by fastening pieces of meat fat to the surfaces of the roast and turning the skewer several times during the cooking.

In broiling steaks and chops the same principle is to be observed—exposure to a hot fire until the surface is as it were sealed, and then to a lower temperature to allow of the proper cooking of the interior without burning the surface or permitting the juices to escape. The broiling or frying of poultry or fish requires somewhat less care and skill. There is a traditional prejudice against fried foods of all kinds, but particularly fried meats, which is very general. However, in the case of meats, if they are fried over a hot fire and as far as possible in their own fat, there is less objection to this method than is generally supposed, and often it appeals to the palate, especially as a grateful change from the routine methods. In the case of certain poultry and fish it is preferable to other methods and quite unobjectionable from the point of view of efficiency.

In cooking vegetables there is an infinite variety of attractive methods and combinations, which a skillful and intelligent cook will employ. The most common fault to be found with vegetables as they are served is that they are either underdone, and, therefore, indigestible, or allowed to remain so long in the oven, the pan, or the pot that they have lost all flavor and a good share of their substance.

The making of highly palatable and nutritious purées by various combinations of vegetables is a culmination of the culinary art to which few American cooks have attained; yet the recipes are simple and inexpensive, and their value as a feature of diet in disease is so great that they merit a more widespread popularity. A cook who understands their preparation will be able through their employment to keep up the carbohydrate factor of the dietary, as otherwise it is quite impossible to do.

Seasonable Changes in the Dietary.—Theoretically there should be a lowering of the fats and, to a less extent, the proteins of the diet with a corresponding increase in the carbohydrates during the warmer months.

As a matter of fact, there is less change in the relative constituency of the average diet than might be expected. The sources of the food supply change, of course, but it is found that there is no constant variation either in the total calories, the chemical constituency, or the relation of animal to vegetable protein. This fact is observed among groups of healthy individuals as well as among the tuberculous when left to their own initiative.

In the season when fresh vegetables and fruits are easily obtainable at small cost there is a tendency toward a higher carbohydrate content, but this is transitory, and the ordinary relation is quickly reestablished in the absence of special effort to the contrary. There is, however, a natural diminution of butcher's meat in the rations of all classes during the very hot weather. This is recognized by patients and healthy persons alike, and should be heeded in constructing a summer diet for a tuberculous invalid. Fish is an especially appropriate substitute at such times, but great care must be exercised in purchasing and shipping fish in the warm weather, owing to its rapid deterioration—to avoid which it must be kept at a very low temperature to the moment of cooking, and even then it is unwise to ship it long distances in the hotter months.

Number and Arrangement of the Meals.—In a large part of this country, especially in rural districts, and almost universally among the laboring class, it is customary to serve the heartiest meal in the middle of the day, and this is the practice, no doubt a wise one, in most sanatoria for the treatment of tuberculosis. Patients should retire early, and to do so soon after a hearty meal is not conducive to rest or sleep.

In private practice, among those who are accustomed to dine in the evening, it is perhaps permissible to continue the arrangement of the meals to which they are accustomed; but even among this class, if it can be done without too great inconvenience and protest on the part of the patient, it is better to change the order and prescribe dinner at noon, and a lighter repast in the evening. "Afternoon tea," which in England is such a universal affair, is not very common in America. There can be no objection to it, however, provided it does not interfere with appetite for supper.

Ordinarily three meals a day suffice for all purposes. They should be punctually and regularly served, and the time given to each should be ample—thirty minutes each for breakfast and supper and forty minutes for dinner is none too much time to allow. Patients should be instructed to be deliberate and to thoroughly masticate their food in order to insure the greatest efficiency of the diet.

Variety.—In arranging a dietary for the tuberculous invalid it is of the first importance that sameness and monotony, both in the preparation of the food and in the material selected, should be avoided. A

menu, however attractive in the first instance, which is repeated at regular and short intervals with persistent routine soon becomes tiresome and repugnant. Each meal should, as it were, come as a surprise to the patient—at least so far as the midday and evening meals are concerned. A patient with a very indifferent appetite is thus often tempted into taking, without coercion, a sufficiently substantial amount of food. Even a healthy individual, if he knows beforehand what each day of the week is going to bring him for dinner, is very apt to lose all zest for the meal before he sits down to the table.

It is a well known principle, and one which Pavlow has demonstrated on dogs, that appetite and a relish for food enhance manyfold the digestion and assimilation functions, and it is certainly not time wasted to spend thought upon any arrangement which is calculated to stimulate the desire for food.

As has been said, the construction of an efficient and at the same time an economic diet is a problem somewhat difficult to solve. It requires a careful inquiry into the relative food values and cost of the various articles on the market and some knowledge of the culinary art. It is a perplexing problem even in the home kitchen under the management of an intelligent housewife, but is much more difficult and complicated in institutional practice.

Bardswell (1), of the King Edward VII Sanatorium in England, has worked out a scheme which he has found to meet the conditions both as to efficiency and economy in a very satisfactory manner. He arranges a bill of fare for the month, with such articles of foodstuffs as the markets afford at the season, from which bill the daily menus are prepared. The average individual portion is indicated on this list, so that the cook may make sufficient allowance in the preparation of the meal with the minimum of waste. The following example is a copy of one of these monthly bills of fare actually employed (September, 1911). The portions indicate averages from which individuals vary in one direction or the other to some extent. It is a fairly generous diet, representing something over 3,000 calories. It will be noticed that a somewhat larger portion is allowed for men than for women:

PATIENTS' DIETARY—BARDSWELL

DIET "A"—MEN

DIET "B"—WOMEN

BREAKFAST

Porridge with Milk.	2 oz.	=	56 gms.
Bread.....	2 oz.	=	56 gms.
Butter.....	$\frac{1}{2}$ oz.	=	14 gms.
Eggs.....	1	=	28 gms.
Bacon.....	1 oz.	=	28 gms.
Tongue, brawn, etc.	1 oz.	=	28 gms.
Herrings.....	1	=	28 gms.

BREAKFAST

Porridge with Milk.	2 oz.	=	56 gms.
Bread.....	$1\frac{1}{2}$ oz.	=	42 gms.
Butter.....	$\frac{1}{2}$ oz.	=	14 gms.
Eggs.....	1	=	28 gms.
Bacon.....	1 oz.	=	28 gms.
Tongue, brawn, etc.	1 oz.	=	28 gms.
Herrings.....	1	=	28 gms.

DIET "A"—MEN

LUNCHEON

Milk.....	½ pt. =	490 gms.
Bread.....	2 oz. =	56 gms.
Butter.....	½ oz. =	14 gms.
Meat.....	3 oz. =	84 gms.
Pudding.....	5 oz. =	140 gms.

DINNER

Milk.....	½ pt. =	490 gms.
Bread.....	2 oz. =	56 gms.
Butter.....	½ oz. =	14 gms.
Meat.....	3 oz. =	84 gms.
Pudding.....	5 oz. =	140 gms.

Potatoes..... }
 Greens..... } q. s.
 Afternoon Tea..... }

DIET "B"—WOMEN

LUNCHEON

Milk.....	½ pt. =	490 gms.
Bread.....	1½ oz. =	42 gms.
Butter.....	½ oz. =	14 gms.
Meat.....	2½ oz. =	70 gms.
Pudding.....	3 oz. =	84 gms.

DINNER

Milk.....	½ pt. =	490 gms.
Bread.....	1½ oz. =	42 gms.
Butter.....	½ oz. =	14 gms.
Meat.....	2½ oz. =	70 gms.
Pudding.....	3 oz. =	84 gms.

Potatoes..... }
 Greens..... } q. s.
 Afternoon Tea..... }

The cost of raw food material in this schema did not (in 1911) exceed 1/6 (36 cents) per person per diem.

In this country a very satisfactory diet for the ambulant, uncomplicated case may be supplied at not to exceed 30 cents per person per diem for raw food material, and in some sections of the country where moderate and low prices prevail the cost of the same diet may fall as low as 25 cents.

The following menus for several days are taken from records of one division of Loomis Sanatorium (Annex), where they were actually employed with satisfactory results from every point of view:

ANNEX DIVISION MENUS FOR ONE WEEK—COST PER PERSON PER DIEM, 30 CENTS

FIRST DAY

BREAKFAST

Oranges
 Shredded Wheat
 Sausage
 Corn Bread
 Bread—Butter
 Coffee—Cocoa
 Milk—Cream

DINNER

Soup
 Fricassee Chicken
 Tomatoes
 Mashed Potato
 Ice Cream
 Bread—Butter
 Milk

SUPPER

Boston Beans
 Catsup
 Chocolate Cake
 Marmalade
 Bread—Butter
 Cocoa—Tea
 Milk

SECOND DAY

Bananas
 Oatmeal
 French Toast
 Maple Syrup
 Bread—Butter
 Coffee—Cocoa
 Milk—Cream

Soup
 Roast Beef
 String Beans
 Boiled Potato
 Rice Pudding
 Bread—Butter
 Milk

Creamed Dried Beef
 Baked Potato
 Apple Sauce
 Bread—Butter
 Cocoa
 Milk

THIRD DAY

Stewed Pears
 Cream of Wheat
 Bacon
 Graham Muffins
 Bread—Butter
 Coffee—Cocoa
 Milk—Cream

Soup
 Boiled Lamb
 Rice
 Peas
 Steamed Pudding
 Bread—Butter
 Milk

Corned Beef Hash
 Peaches
 Spice Cake
 Bread—Butter
 Cocoa
 Milk

FOURTH DAY

BREAKFAST

Prunes
Oatmeal
Griddle Cakes
Maple Syrup
Bread—Butter
Milk—Cream
Coffee—Cocoa

DINNER

Soup
Roast Beef
Potato
Corn
Tapioca Pudding
Bread—Butter
Milk

SUPPER

Cold Sliced Meat
Fried Potato
Mixed Pickle
Cookies
Bread—Butter
Cocoa—Milk

FIFTH DAY

Bananas
Pettijohns
Cod Fish Cakes
Rolls
Bread—Butter
Milk—Cream
Coffee—Cocoa

Soup
Corned Beef
Potato
Cabbage
Pie—Cheese
Bread—Butter
Milk

Lamb Stew
Vegetables
Cinnamon Rolls
Bread—Butter
Cocoa—Milk

SIXTH DAY

Stewed Figs
Hominy
Eggs
Bread—Butter
Milk—Cream
Coffee—Cocoa

Soup
Fish
Potato
Tomatoes
Bread Pudding
Bread—Butter
Milk

Macaroni—Cheese
Layer Cake
Pineapple
Bread—Butter
Cocoa—Milk

SEVENTH DAY

Rhubarb
Oatmeal
French Toast
Syrup
Bread—Butter
Coffee—Cocoa
Milk—Cream

Soup
Steak
Potato
Lima Bean
Baked Custard
Bread—Butter
Milk

Cold Ham
Creamed Potato
Lemon Jelly
Soda Biscuit
Bread—Butter
Cocoa—Milk

A group of forty patients on varying grades of exercise, with a few "complete rest" cases, made satisfactory weight gains, and in other respects did well on this diet, averaging somewhat over 3,100 calories, with approximately 150 grams protein.

In another division of Loomis Sanatorium (Intermediate Division) during the same period a more expensive diet was served—an example of which is given in the following list of menus for seven days. The actual consumption of food from this diet by a group of fourteen patients, equally divided as to sex, was somewhat less than in the former case; the results as to weight gains, etc., were about the same, and quite satisfactory. The additional cost is due, of course, to the more expensive articles comprised in the menus:

INTERMEDIATE DIVISION MENUS FOR ONE WEEK—COST PER PERSON PER DIEM, 40 CENTS

FIRST DAY

BREAKFAST

Grape Fruit
Farina
Omelet
Muffins
Butter
Coffee—Cocoa
Milk—Cream

DINNER

Tomato Bisque
Roast Duck
Stuffing
Gooseberry Jam
Creamed Onions
Mashed Potato
Ice Cream
Bread—Butter
Milk

SUPPER

Cold Roast Beef
Browned Potato
Cocoanut Cake
Bread—Butter
Cocoa—Tea
Milk

Bananas
Oatmeal
Boiled Eggs
Rolls
Butter
Coffee—Cocoa
Milk—Cream

SECOND DAY

Bouillon
Roast Spare Ribs
Sauerkraut
Sweet Potato
Boiled Potato
Plum Pudding
Brandy Sauce
Milk

Roast Beef Hash
Chicken Salad
Lemon Jelly
Whipped Cream
Bread—Butter
Cocoa—Tea
Milk

Oranges
Wheatena
Eggs
Potato Scones
Bread—Butter
Coffee—Cocoa
Milk—Cream

THIRD DAY

Bean Purée
Roast Veal
Potato
Parsnips
Lettuce
Pie
Bread—Butter
Milk

Lamb Chops
Boiled Rice
Plums
Cake
Bread—Butter
Tea—Cocoa
Milk—Cream

Apricots
Saxon Wheat
Bacon
Griddle Cakes
Syrup
Bread—Butter
Coffee—Cocoa
Milk—Cream

FOURTH DAY

Vegetable Soup
Broiled Steak
Tomatoes
Potato
Tapioca Pudding
Bread—Butter
Milk

Cold Ham
Creamed Potato
Fruit Salad
Boston Cookies
Raspberries
Bread—Butter
Cocoa—Tea
Milk

Prunes
Pettijohns
Eggs to order
Muffins
Bread—Butter
Coffee—Cocoa
Milk—Cream

FIFTH DAY

Soup
Roast Beef
Browned Potato
Beets
Steamed Pudding
Foamy Sauce
Bread—Butter
Milk

Lamb Stew
Biscuit
Peaches
Cake
Bread—Butter
Tea—Cocoa
Milk

Oranges
Oatmeal
Cod Fish Cakes
Rolls
Butter
Coffee—Cocoa
Milk—Cream

SIXTH DAY

Soup
Fish
Asparagus
Potato
Rice Pudding
Bread—Butter
Milk

Steak
French Fried Potato
Lettuce
Pears
Cookies
Bread—Butter
Cocoa—Milk

Bananas
Hominy
Bacon
Corn Bread
Bread—Butter
Coffee—Cocoa
Milk—Cream

SEVENTH DAY

Cream Soup
Roast Lamb
Potato
Corn
Baked Custard
Caramel Sauce
Bread—Butter
Milk

Cold Meat
Macaroni
Tomatoes
Apple Sauce
Layer Cake
Bread—Butter
Cocoa—Tea
Milk

It will thus be seen that a well-balanced and efficient diet for the ordinary tuberculous patient may be constructed at a cost for raw food material of thirty, or in some sections possibly as low as twenty-five, cents per person per diem. It will be seen also that the cost increases rapidly as the diet becomes more elaborate, even without any increase in the nutrition value.

In institutions for paupers and incompetents, where actual physical disease has not to be considered, it is quite possible to furnish a ration which shall have the necessary calorific value and a sufficient protein content for as little as fifteen or sixteen cents per person per diem, and in several institutions of the sort such a low cost is actually maintained. But, while a diet so constructed may be practicable and efficient under such circumstances, it would be an extremely hazardous and unjustifiable experiment to attempt to reduce the cost of diet to any such figures in the case of tuberculous invalids in or out of institutions. Indeed, it would be of very doubtful expediency to attempt to reduce the cost in the latter case much below thirty or possibly, under some circumstances, twenty-five cents at the present price of foodstuffs (1911).

Diet in Far Advanced, Acute, and Complicated Cases.—During acute exacerbations arising in the course of an otherwise favorable case, such as may follow an “overdose” of exercise or tuberculin, there is no indication for any special change in the ordinary dietary, although the patient, being immobilized, i. e., placed on, “absolute rest” and during the period of fever, will naturally take less food owing to the incidental falling off in appetite. This need excite no apprehension, nor is it per se a condition calling for supplementary diets of eggs and milk. The patient will in fact do better if not disturbed by any departure from the food routine to which he has become accustomed.

But in cases of progressive disease and continued hyperpyrexia, or in the presence of certain complications, it will often become necessary to make more or less radical changes both in the constituency and the frequency of the diet, with a view of maintaining a sufficient nourishment. In “far advanced” and progressive cases, where the patient has lost all appetite for regular meals, and has a repugnance for food as ordinarily served, it is wise to give small quantities at frequent intervals for such a period as conditions will determine. It is an excellent practice in such cases to divide the total amount of food to be given into eight parts, to be given at two-hour intervals through the day, the larger portions coming at the regular meal hours.

The following “two-hour” diet is one which has been found very serviceable in these cases in the hospital of Loomis Sanatorium. It affords a sufficient variety and total quantity in such small portions as not to excite repugnance even when there is a decided anorexia:

REGULAR TWO-HOUR DIET

FIRST DAY

6.00 A. M.		
Milk.....	6 oz.	= 170 gms.
1 Raw Egg		
8.00 A. M.		
Orange.....	3 oz.	= 90 gms.
Oatmeal.....	3 oz.	= 90 gms.
Cream—Sugar		
2 Soft Cooked Eggs		
10.00 A. M.		
Broth.....	4 oz.	= 120 gms.
Toast.....	½ oz.	= 14 gms.
Beef Juice.....	3 oz.	= 90 gms.
12.00 M.		
Soup.....	4 oz.	= 120 gms.
Chicken.....	1½ oz.	= 42 gms.
Potato.....	2 oz.	= 60 gms.
Ice Cream.....	3 oz.	= 90 gms.
2.00 P. M.		
Hot Chocolate....	4 oz.	= 120 gms.
Bread-Butter Sandwich.....	1 oz.	= 28 gms.
4.00 P. M.		
Milk.....	6 oz.	= 170 gms.
Beef Juice.....	3 oz.	= 90 gms.
6.00 P. M.		
Broth.....	4 oz.	= 120 gms.
Stewed Fruit.....	2 oz.	= 60 gms.
Scraped Beef Sandwich —Beef... 1 oz. }		
—Bread.. ½ oz. }		= 42 gms.
8.00 P. M. }	Milk.. 6 oz.	= 170 gms.
10.00 P. M. }		

THIRD DAY

6.00 A. M.		
Milk.....	6 oz.	= 170 gms.
1 Raw Egg		
8.00 A. M.		
Fruit.....	3 oz.	= 90 gms.
Bacon.....	1 oz.	= 28 gms.
Potato.....	1 oz.	= 28 gms.
Toast.....	1 oz.	= 28 gms.
Coffee		
10.00 A. M.		
Shredded Wheat....	1	= 35 gms.
Cream.....	1½ oz.	= 42 gms.
Sugar		
1 Raw Egg		
12.00 M.		
Chicken Broth....	4 oz.	= 120 gms.
Rice.....	1 oz.	= 28 gms.
Beef Sandwich		
2.00 P. M.		
Egg Orangeade (1 albumin—1 orange)		
Beef Juice.....	3 oz.	= 90 gms.
4.00 P. M.		
Milk.....	6 oz.	= 170 gms.
1 Raw Egg		

SECOND DAY

Milk.....	6 oz.	= 170 gms.
1 Raw Egg		
Grapes.....	3 oz.	= 90 gms.
Cream of Wheat.....	3 oz.	= 90 gms.
Cream—Sugar		
Butter.....	½ oz.	= 14 gms.
Bread.....	½ oz.	= 14 gms.
Cocoa.....	3 oz.	= 90 gms.
Toast.....	½ oz.	= 14 gms.
Beef Juice.....	3 oz.	= 90 gms.
Cream Soup.....	4 oz.	= 120 gms.
Lamb Chop.....	1½ oz.	= 42 gms.
Potato.....	2 oz.	= 60 gms.
Bread—Butter		
Beef Juice.....	3 oz.	= 90 gms.
1 Raw Egg		
Milk.....	6 oz.	= 170 gms.
1 Raw Egg		
Beef Broth.....	4 oz.	= 120 gms.
Lettuce Salad.....	1 oz.	= 28 gms.
Toast.....	½ oz.	= 14 gms.
Milk.....	6 oz.	= 170 gms.

FOURTH DAY

Milk.....	6 oz.	= 170 gms.
1 Raw Egg		
Fruit.....	3 oz.	= 90 gms.
Cocoa.....	4 oz.	= 120 gms.
Toast.....	½ oz.	= 14 gms.
1 Raw Egg		
Lettuce Sandwich		
Milk.....	6 oz.	= 170 gms.
Beef Juice.....	3 oz.	= 90 gms.
1 Raw Egg		
Thick Soup.....	4 oz.	= 120 gms.
Chicken.....	1 oz.	= 28 gms.
Potato.....	1 oz.	= 28 gms.
Celery.....	1 oz.	= 28 gms.
Ice Cream.....	3 oz.	= 90 gms.
Rice Pudding.....	2 oz.	= 60 gms.
Bread—Butter		
Milk.....	6 oz.	= 170 gms.
1 Raw Egg		

THIRD DAY

6.00 P. M.
 Steak.....2½ oz. = 75 gms.
 Potato.....1 oz. = 28 gms.
 Baked Apple.....3 oz. = 90 gms.
 Bread—Butter
 8.00 P. M. }
 10.00 P. M. } Milk..6 oz. = 170 gms.

FOURTH DAY

Scraped Beef Sandwich
 Fruit Salad.....2½ oz. = 75 gms.
 Beef Juice.....3 oz. = 90 gms.
 Milk.....6 oz. = 170 gms.

FIFTH DAY

6.00 A. M.
 Milk.....6 oz. = 170 gms.
 1 Raw Egg
 8.00 A. M.
 Cream of Wheat....3 oz. = 90 gms.
 Cream—Sugar
 Toast
 Coffee
 10.00 A. M.
 Egg Lemonade
 Beef Juice
 12.00 M.
 Soup.....4 oz. = 120 gms.
 Scraped Beef Sandwich
 Celery or Onion....1 oz. = 28 gms.
 2.00 P. M.
 Broth.....4 oz. = 120 gms.
 Bread—Butter
 4.00 P. M.
 Milk
 1 Raw Egg
 6.00 P. M.
 Cornmeal Mush....3 oz. = 90 gms.
 Cream—Sugar
 Fruit.....3 oz. = 60 gms.
 Milk
 8.00 P. M. }
 10.00 P. M. } Milk..6 oz. = 170 gms.

SIXTH DAY

Milk.....6 oz. = 170 gms.
 1 Raw Egg
 Fish.....2 oz. = 60 gms.
 Toast
 Beef Juice
 Coffee
 Cocoa
 1 Raw Egg
 Steak.....2½ oz. = 75 gms.
 Potato
 Custard.....3 oz. = 90 gms.
 Milk
 Gruel.....3 oz. = 90 gms.
 Milk
 Beef Juice
 Omelette.....3 oz. = 90 gms.
 Toast.....1 oz. = 28 gms.
 Apple Sauce.....3 oz. = 90 gms.
 Milk.....6 oz. = 170 gms.

SEVENTH DAY

6.00 A. M. Milk.....6 oz. = 170 gms.
 1 Raw Egg
 8.00 A. M. Bacon.....1 oz. = 28 gms.
 Toast
 Coffee
 10.00 A. M. Grape Nuts.....2 oz. = 60 gms.
 Cream
 1 Raw Egg
 12.00 M. Roast Beef.....2 oz. = 60 gms.
 Apple-nut Salad.....2 oz. = 60 gms.
 Bread—Butter
 2.00 P. M. Milk (4) Toast (1) oz.
 Milk
 4.00 P. M. Beef Juice
 1 Raw Egg
 6.00 P. M. Lamb Chop.....1½ oz. = 42 gms.
 Potato
 Junket
 Toast
 Beef Juice
 8.00 P. M. }
 10.00 P. M. } Milk.....6 oz. = 170 gms.

This is a well-balanced ration averaging about 2,500 calories and, if well borne, will maintain nutrition or even effect weight gain in spite of high temperature and progressive disease.

It sometimes happens, however, that such a diet is not well borne, and appears to cause gastric and intestinal disturbance, or at least to cause in the patient a sense of discomfort. In such cases, or when there is reason to believe that the diet may be in part the cause of temperature, as imposing too great a strain on the digestive functions a semiliquid or, in extreme cases, a liquid diet may be substituted and often successfully. Following are examples of such diets which have been found in actual experience very satisfactory:

TWO-HOUR SEMI-LIQUID DIET

FIRST DAY

8.00 A. M.	Plums		
	Farina.....	.4	oz. = 120 gms.
	Toast.....	.1	oz. = 28 gms.
	Cocoa.....	.4	oz. = 120 gms.
	Cream.....	.4	oz. = 120 gms.
	Butter.....	$\frac{1}{2}$	oz. = 14 gms.
10.00 A. M.	Beef Juice.....	.3	oz. = 90 gms.
12.00 M.	Cream of Pea Soup		
	Zwieback.....	.1	oz. = 28 gms.
	Butter		
	Ice Cream.....	.3	oz. = 90 gms.
	Milk.....	.6	oz. = 170 gms.
2.00 P. M.	1 Raw Egg		
4.00 P. M.	Milk.....	.6	oz. = 170 gms.
6.00 P. M.	Milk.....	.6	oz. = 170 gms.
	Toast.....	.1	oz. = 28 gms.
	Butter.....	$\frac{1}{2}$	oz. = 14 gms.
	Junket.....	.3	oz. = 90 gms.
8.00 P. M.	Cocoa.....	.5	oz. = 140 gms.
AVERAGE	Protein.....		120 gms.
	Fats.....		138 gms.
	Carbohydrates.....		225 gms.
	Calories.....		2,622

SECOND DAY

8.00 A. M.	Oranges
	Pettijohns
	Toast
	Butter
	Cocoa
	Cream
10.00 A. M.	Beef Juice
12.00 M.	Cream of Tomato
	Zwieback
	Butter
	Charlotte Russe
	Milk
2.00 P. M.	1 Raw Egg
4.00 P. M.	Milk
6.00 P. M.	Cocoa
	Toast
	Butter
	Custard
8.00 P. M.	Milk

THIRD DAY

Grapes
Oatmeal
Toast
Butter
Cocoa
Cream
Beef Juice
Cream of Spinach
Zwieback
Butter
Junket
Milk
1 Raw Egg
Milk
Milk
Rice
Toast
Butter
Cocoa

Quantities for second and third days relatively the same as for first day.

2,000 CALORIES—LIQUID DIET

8.00 A. M.	Cocoa.....	1 cup (small)
	Eggs.....	2
	Milk.....	1 cup
	Orange Juice.....	(1)
10.00 A. M.	Eggnog.....	{ 1 Egg 1 cup Milk }
12.00 M.	Soup.....	1 cup
	Milk.....	1 cup
	Junket.....	4 oz. = 720 gms.
	Egg.....	1
2.00 P. M.	Cocoa.....	1 cup (small)
	Beef Juice.....	3 oz. = 90 gms.
4.00 P. M.	Milk.....	1 cup
	Egg.....	1
6.00 P. M.	Cocoa.....	1 cup (small)
	Milk.....	1 cup
	Eggs.....	2
8.00 P. M.	Hot Milk.....	1 cup
AVERAGE	Milk.....	48 oz. = 1,350 gms.
	Cocoa.....	13 oz. = 370 gms.
	Raw Eggs.....	7
	Soup.....	6 oz. = 170 gms.
	Beef Juice.....	3 oz. = 90 gms.
	Junket.....	4 oz. = 120 gms.
	Sugar.....	1 oz. in Cocoa
	Orange Juice.....	3 oz. = 90 gms.

These semiliquid and liquid diets will be found especially serviceable in certain laryngeal cases, characterized by more or less distressing dysphagia, although such cases sometimes have a greater tolerance for solids than liquids.

It is scarcely necessary to point out that the expense of such dietaries is considerable, not only because of the greater cost of material, but on account of the greatly increased service (nurse or dietitian) required.

Constipation and diarrhea, arising from various causes, are not uncommon in the course of chronic tuberculosis. When due to extensive tuberculous involvement of the intestines, little can be expected from any form of treatment, but in any case better results can be expected from suitable modification of the diet than from any other method.

An obstinate constipation is frequently corrected by a diet similar to the following:

ANTI-CONSTIPATION DIET

FIRST DAY	SECOND DAY	THIRD DAY
7.00 A. M.		
Orange Juice	Orange Juice	Orange Juice
BREAKFAST		
Apples	Figs	Pears
Oatmeal	Pettijohns	Shredded Wheat
Cream	Cream	Cream
Sugar	Sugar	Sugar
Egg—1	Lamb Chops	Omelette
Coffee	Coffee	Coffee

TUBERCULOSIS

	<i>FIRST DAY</i>	<i>SECOND DAY</i>	<i>THIRD DAY</i>
DINNER			
	Chicken	Roast Beef	Roast Lamb
	Celery	Cauliflower	Peas
	Asparagus	Spinach	Carrots
	Brown Bread	Rye Bread	Brown Bread
	Butter	Butter	Butter
4.00 P. M.			
	Buttermilk	Buttermilk	Buttermilk
SUPPER			
	Lamb Chops	Broiled Chicken	Fillet of Beef
	Salad	Salad (Tomato)	Salad
	Honey	Brown Bread	Rye Bread
	Graham Bread	Butter	Butter
	Butter	Stewed Prunes	Apple Sauce
8.00 P. M.			
	Stewed Fruit	Fruit	Fruit

In the case of diarrhea it is wise to concentrate the diet as much as possible. The following example of such a diet has proved very satisfactory in such cases and permits of sufficient variety to be acceptable to most patients over protracted periods:

CONCENTRATED DIET

	<i>FIRST DAY</i>	<i>SECOND DAY</i>	<i>THIRD DAY</i>
BREAKFAST			
	Hominy.....3 oz. = 90 gms.	Same, but vary style of serving eggs.	
	Cream.....1 oz. = 28 gms.		
	Sugar		
	Eggs.....2		
	Cocoa.....4 oz. = 120 gms.		
	Toast.....1 oz. = 28 gms.		
	Butter..... $\frac{1}{2}$ oz. = 14 gms.		
DINNER			
	Roast Lamb.....2 oz. = 60 gms.	Broiled Chicken	Roast Beef
	Rice.....5 oz. = 140 gms.	Baked Potato	Rice
	Milk.....1 cup	Milk	Zwieback
	Zwieback..... $\frac{1}{2}$ oz. = 14 gms.	Zwieback	Butter
	Butter..... $\frac{1}{2}$ oz. = 14 gms.	Butter	Milk
SUPPER			
	Baked Potato.....3 oz. = 90 gms.	Lamb Chops—2	Squab (or Chicken)
	1 Egg (Omelette)	Rice	Baked Potato
	Zwieback..... $\frac{1}{2}$ oz. = 14 gms.	Zwieback	Zwieback
	Butter..... $\frac{1}{2}$ oz. = 14 gms.	Butter	Butter
	Milk	Milk	Milk
AVERAGE			
	Protein.....110 gms.		
	Fats.....115 gms.		
	Carbohydrates.....260 gms.		
	Calories.....2,500		

Hyperchlorhydria is another condition arising frequently in certain stages of tuberculosis, to meet which an "antiacid" diet is the most effective weapon available. Such a diet is the following, which is often sufficient to correct the trouble without other recourse:

ANTIACID DIET—LIBERAL

8.00 A. M.	
Choice	{ Broiled Veal..... 70 gms.
	{ Stewed Veal.....100 gms.
	{ Beef Steak..... 70 gms.
	{ Fowl..... 70 gms.
Choice	{ Toast..... 30 gms.
	{ Zwieback..... 20 gms.
	Egg.....1
	Butter..... 20 gms.
10.00 A. M.	
	Milk.....500 c. c.
	Toast..... 40 gms.
	Butter..... 20 gms.
12.00 M.	
Choice	{ French Soup with Yolk of Egg
	{ Raw Meat—Beef Steak..200 gms.
	{ Broiled or Boiled Fowl...140 gms.
	{ Broiled or Boiled Fish...140 gms.
	Asparagus Heads.....100 gms.
	Toast..... 20 gms.
	Omelette Soufflé.....120 gms.
	Butter..... 10 gms.
	Black Coffee.....Small Cup
4.00 P. M.	
	Milk.....250 c. c.
	Zwieback..... 60 gms.
	Butter..... 20 gms.
6.00 P. M.	
Choice	{ Cold Meat..... 70 gms.
	{ Meat Jelly.....100 gms.
	Toast..... 20 gms.
	Swiss or Dutch Cheese... 20 gms.
	Butter..... 20 gms.
AVERAGE	
	Protein..... 98 gms.
	Fats.....132 gms.
	Carbohydrates.....269 gms.
	Calories.....2,736

ANTIACID DIET—STRICT

Milk.....200 gms.
Soft Boiled Eggs..... 2
Toast..... 60 gms.
Butter..... 30 gms.
Egg.....1
Chicken or Broiled Meat..100 gms.
Spinach or Asparagus...100 gms.
Stale Bread.....100 gms.
Butter..... 30 gms.
Milk.....150 c. c.
Crackers..... 50 gms.
Butter..... 30 gms.
Milk.....100 gms.
Butter..... 25 gms.
Zwieback..... 20 gms.
Soft Boiled Egg.....1
AVERAGE
Protein..... 88 gms.
Fats.....166 gms.
Carbohydrates.....215 gms.
Calories.....2,787

Other indications arise in the course of many cases of tuberculosis which demand special dietetic consideration, but, as a rule, they are not due to conditions peculiar to tuberculosis and will be treated in other portions of this work to which they more properly belong. Diabetes mellitus and other forms of glycosuria, for instance, are not infrequent complications in tuberculosis, which preëminently call for dietetic treatment.

The recent work of Schmidt has thrown new light upon certain intestinal conditions which occur more or less frequently in tuberculosis, though by no means peculiar to it, characterized on the one hand by excessive fermentation, and on the other by putrefaction, and attended in both cases by diarrhea, but indicating quite different dietetic procedures. In the former a restriction of the carbohydrate element and in the latter of the protein (especially of animal protein) in the diet is indicated.

Alcohol.—There has been much discussion, pro and con, as to the

value of alcoholic beverages in the diet of the tuberculous invalid. The occasional abuse of alcohol among all classes is, of course, to be deplored, and has led reactionists to take the stand that, being unnecessary, it should be rigidly excluded in all cases. Such practice, while not fraught with the dangers that attend indiscriminate license, often in cases that are actually harmed by its use, is none the less unwise, and at times, no doubt, prejudicial to the best interests of the patient.

The somewhat widespread belief that alcohol itself is fattening is a fallacy, although some alcoholic beverages, e. g., the malt liquors, contain besides the alcohol certain extractives which are available to the body as food. However, this is no argument in favor of its employment, for these elements may be supplied without the alcohol. The real value of alcohol in diet is due to its sparing effects upon the fats and carbohydrates. Atwater and Benedict (*Memoirs of the National Academy of Science*, 1902) have shown that within limits it may be used in the body economy in place of isodynamic quantities of these two elements.

A bottle of ordinary table claret, containing approximately 70 grams of alcohol, for instance, supplies 500 calories, and may be substituted for an equal calorific value in fats or carbohydrates without perceptible change in metabolism. Hence, it follows that, when the carbohydrate content of the diet cannot be brought up to the desired quantity, the addition of a little wine or beer to the diet may be of distinct advantage.

In hyperacidity alcohol in any form is contraindicated, and it is valueless in cases with normal gastric secretion, but as a stomachic in cases of hypoacidity, loss of appetite, and consequent impairment of digestion the lighter wines and malt liquors may be prescribed to advantage. For such a purpose a beverage containing from five to ten per cent. alcohol is all-sufficient, and because of their additional nutritive value the malt liquors are preferable to wines if they are well borne.

The heavier wines and distilled liquors containing high percentages of alcohol have no place in dietetic treatment and should be employed only as medicine.

There is a growing tendency to regard a suitable diet in tuberculosis as not differing essentially from that in health. In the absence of complications and among cases pursuing a favorable course such a view is probably correct, but in consideration of the character and especially the chronicity of the disease, with the emaciation which is commonly one of its most striking features, the physician is forced to direct his attention to the question of nourishment, and for this reason diet in tuberculosis must continue to hold a prominent place in the therapeutics of the disease.

As regards constant deviation from the normal in the gastrointestinal system, in otherwise uncomplicated pulmonary tuberculosis, there are certain conditions which are met with so often as to suggest at least a definite relation to the disease. From a large number of examinations

of stomach contents following test meals made in the laboratories of Loomis Sanatorium, the conclusions were reached that:

(a) In the *active* "*incipient*" cases the total acidity and motility are increased.

(b) In the *inactive* "*incipient*" stage there is shown no uniform disturbance in these factors, only such as is found in non-tuberculous cases.

(c) In "*moderately*" and "*far advanced*" cases, active and inactive, the tendency inclines to a lowered total acidity and motility, especially in the active stage.

It will be seen, therefore, that in certain stages of the disease there are indications for special dietetic consideration which cannot wisely be neglected if the best results are to be expected.

ADVICE TO PATIENTS AFTER DISCHARGE FROM TREATMENT

The responsibility of the physician does not end with the discharge of the patient from a sanatorium, or from treatment at a resort or at his home. In the great majority of cases the questions arise, "What sort of employment shall I seek that will best conserve my health and at the same time give me a living wage?" and "Where shall I seek it?"

It has been the custom to advise tuberculous individuals who have attained an arrest of the disease, or are sufficiently improved to undertake some self-supporting occupation, to get work in the open air, in the country, and, if possible, in the mountains. Now, such advice, while it sounds plausible enough, is quite impracticable in ninety-nine cases in the hundred.

In the first place, this field of employment is a very limited one, generally simmering down to some branch of agriculture. Farming under modern conditions is suitable only for those who possess experience or a considerable capital, and even then makes physical demands beyond the strength and endurance of most patients immediately after discharge.

The successful small farmer is an exceedingly hard-working and self-sacrificing man, who has to be content with small profits, a meager diet, and long hours. The farm laborer is in a still worse case, with the small pay, long hours, and heavy work; even healthy men are not long-lived in it.

Aside from such considerations, there are two serious objections to agricultural pursuits for this class of individuals. First, the great majority of tuberculous patients are city bred and educated, with no experience in or taste for such pursuits, and if given the opportunity could not fulfill the requirements; they could not earn enough to supply themselves with the necessities which their condition demands. And, second, the opportunities for such employment are entirely inadequate to the demand.

It is obvious that, if a patient with an arrested disease is obliged to enter upon an occupation for which he has not the slightest aptitude, he will have to face hardship and privation best calculated to undo what has been done, and leave him worse off than he was in the first place.

A patient who has had a good sanatorium training and attained an arrest of his disease will, in the majority of cases, do better to return to his former occupation, provided it is not peculiarly unhealthy, than to attempt to make a living in a field entirely new. He will, as a rule, be able to earn a better wage with much less effort; he will be better able to save himself the anxiety and nervous strain common to any unfamiliar occupation, and he will, as a rule, be able to command much better home conditions as to food, etc., than would otherwise be possible.

Under all conditions relapses will occur, and, even among apparently thoroughly arrested cases in patients who have been brought under treatment in the early and most favorable stages of the disease, one finds many instances of ultimate failure. This is quite inevitable and should in no wise discourage continued effort nor a hopeful view of the situation.

But the experience of many who have struggled with the problems of tuberculosis, both in the sanatorium and in private and dispensary practice, has taught that fewer relapses occur among patients of the working class who return to their former occupations than is the case with those who attempt to earn a living in other fields in which they have no experience, although under supposedly better hygienic conditions.

After all, as has been said elsewhere, it is more important from the standpoint of health what the patient does out of working hours than in them. If he has been well instructed and is fairly intelligent and conscientious, his chances of remaining well are excellent, even though he is obliged to work in a store or factory eight hours a day, and such an one will often remain well, while others, whose circumstances permit of a life of idleness, relapse and die, largely through that false sense of security which financial affluence gives, with the resulting relaxation of self-discipline.

It is, therefore, important that the treatment of tuberculosis in any case should be planned and carried out with a view to subsequent occupation; that the patient should be trained as far as possible along lines which will make his return to his former occupation practicable, and that in the final steps of his "cure" he should be placed, as nearly as possible, under those conditions which he will have to meet later. Such a course will simplify the problem of advice upon discharge and will do all that can be done to forfend against subsequent relapse.

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CHAPTER XXVI

ROCKY MOUNTAIN SPOTTED FEVER

ED. E. MAXEY

Recent investigations, especially by Ricketts (15), have demonstrated quite conclusively that this condition is an acute infection, "a generalized invasion of the body by a microorganism which, as yet, is unrecognized and uncultivated" (15f). More recently Ricketts (15g), in reporting on his efforts to isolate the causal microorganism, said that the form most commonly found by him was two somewhat lanceolate chromatin-staining bodies, separated by a slight amount of eosin-staining substance—a somewhat pleomorphic bacillus. It has, he says, a striking resemblance to the bacillus of hemorrhagic septicemia, and, in this connection, he calls attention to the important fact that spotted fever is a hemorrhagic septicemia. A long-lasting immunity follows recovery from this disease (15f; 16). I am unable to find any authentic record where recovery has been followed by a second attack. The only known method by which spotted fever can be transmitted to man is through the bite of a tick—one or more varieties of the wood-tick (*Dermacentor*) (9, 15).

The geographical distribution of this disease, so far as I am able to determine, is limited to western Montana, central and southern Idaho, eastern Oregon, northern Utah, Colorado, California, and Nevada, western Wyoming, and possibly a few cases in eastern Washington, northern Idaho, and the Klondike region of Alaska. The most malignant form of the disease is found in Montana, where the mortality is reported as high as 85 per cent. (14). In other infected areas the mortality is not so high, about the same as typhoid fever.

The more important clinical characteristics of Rocky Mountain spotted fever are constipation, arthritis and muscular pains, continuous moderately high fever, and a petechial or purpuric eruption in the skin, appearing first on the ankles, wrists, and forehead, but rapidly spreading to all parts of the body (6).

Owing to the fact that few or no observers are prepared to say that we have a specific treatment for spotted fever, and also to the further fact that the malignancy of the disease varies in different localities, the

treatment may be said to be entirely symptomatic, and the methods of physicians are found to vary somewhat in the different regions affected. We find it convenient to discuss treatment under the following subdivisions: 1. Prophylactic treatment. 2. General and local treatment. 3. Serum treatment.

PROPHYLACTIC TREATMENT

We can now safely assert that Rocky Mountain spotted fever is a preventable disease. Knowing, as we do, that the tick is the conveyor of the disease to man, the following preventive measures become manifest (15f):

"1st. The avoidance of localities in the spring of the year which are known to harbor infected ticks.

"2d. Individual precaution on the part of those who from necessity of occupation are exposed to infection." This may be attained by (a) avoiding personal contact with brush, weeds, grass, etc., on which the ticks may be resting; (b) the wearing of tick-proof clothing, or removal of *all* clothing once or twice daily, on returning to house or camp, and examining body and clothing carefully for ticks; (c) using moth-balls, naphthalene, camphor, oil of peppermint, etc., freely in bedding and clothing; and, (d) when the tick has become attached to the body, its careful removal and cauterization of the "bite." The tick is usually easily removed by applying to it a drop of ammonia water, kerosene, or turpentine. The "tick-bite" should then be cauterized with pure carbolic acid. If the tick has been attached longer than a few hours and is difficult to remove, the "tick-bite" should then be excised and cauterized, or, in other words, treated as a "snake-bite" should be treated. All ticks removed from the body of the patient should be carefully destroyed, for it has been demonstrated conclusively that a single individual tick may infect two or more persons (9).

"3d. Measures to decrease the number of ticks in localities where the disease is known to exist. Probably the most important of these is to oil the horses, cattle, and other domesticated animals known to harbor ticks; this process to be resorted to during the season when the ticks mature and prepare to lay eggs; that is, from February to latter part of June. This method is effective because it renders impossible the laying of eggs for the next year's crop of ticks. Other valuable means of exterminating the tick are to destroy the brush and timber which protect the tick, its eggs, and its young from the destructive effect of the sun's rays" by cutting and burning, or, perhaps better still, by pasturing or grazing sheep and goats over infected area. Frick (3a) has recently shown that the tick *Dermacentor* soon dies when placed on a sheep, thus adding another means of eradication; and, as it seems probable from the

investigations of Ricketts (15d and f), "that certain of the small, burrowing animals and other rodents (ground-squirrel, wood-chuck, or ground-hog, rock-squirrel, chipmunk, pine-squirrel, rabbit, etc.) are important agents in keeping the ticks alive, inasmuch as they serve very extensively as hosts for the tick, particularly during their larval and nymphal stages, the destruction of these animals, so far as possible in an infected district, would tend to limit the development of ticks," and, incidentally, the number of cases of spotted fever in that particular district. But to accomplish all this state aid is imperative (24), as little can be accomplished by individual effort in freeing a locality of infected ticks. Laws which will provide for the oiling of cattle and horses in infected areas are required, and stock of all kinds should not be allowed driven from infected districts through towns or other non-infected districts, without first having been rendered free of ticks by oiling or dipping.

GENERAL AND LOCAL TREATMENT

From the time of the bite by an infected tick to the development of definite symptoms, there is an incubation period of from three to nine days, during which time, or most of the time, the patient may feel entirely well, or he may experience obscure and indefinite sensations, especially constipation and more or less headache and general malaise. At this time the patient may not know that he has been bitten by a tick, the tick or tick-bite (if the tick has fed and dropped off) often not being discovered until the characteristic symptoms develop. Usually, when the physician first sees these cases, the patient is complaining of considerable headache and pains in the legs, back, etc., and has from one to three degrees of fever. In the Montana cases, however, the pains are not a very prominent early symptom (3).

When first seen the patient should be given a hot bath, and ordered to bed. A generous dose of *calomel* and *soda*, to be followed by an efficient *saline*, should be given at once, and the patient instructed to *drink freely of water*.

A great number and variety of drugs have been suggested for the relief of the *pains* which are a more or less constant accompaniment of this disease, especially during the first ten days. Probably the best remedy for the relief of the pains is *aspirin* (McCalla, Mills, Numbers, Smith, Springer, Stewart), in doses of 0.32 to 0.65 gm. (5 to 10 grs.), repeated every two to four hours. The size and frequency of dose should depend entirely on the effect it has on the pains, care being exercised to avoid overdosage and to follow each dose with a copious draft of water. Phenacetin (Bowers, Dodds, McCalla, Numbers, Shirley, Smith, Taylor), salol (Shirley), and the salicylates (Bowers, Mather, Mills,

Numbers) may also be used, while some physicians resort to the use of acetanilid (Taylor), the bromids (Numbers, Springer), quinin (McCalla, Mooser, Taylor), and antipyrin (Springer), in varying dosage and combinations. In the more malignant type of the disease some use dry heat, or sponge the patient with a hot 2-5 per cent. solution of phenol (McCullough), and more frequently resort is made to the use of morphin (Dodds, Kellogg).

In the writer's opinion, however, it is rarely necessary or advisable to prescribe morphin or other form of opiate in these cases. If the bowels have been properly cleansed, there are few cases that will not be made comfortable by the intelligent use of aspirin and hot baths (Bowers, Mills), or dry heat.

If the remedies given to relieve the pains are not also sufficient to keep the *fever* within reasonable bounds, *hydrotherapy* (Bowers, Dodds, McCalla, Mills, Numbers, Pease, Smith, Springer, Stewart) may be resorted to with confidence. Cold sponge baths and cold packs are sufficient in most cases of hyperpyrexia; tubbing can be used where these fail to reduce the temperature. Mills recommends bathing the patient in hot water, gradually bringing the temperature of the water up to 120° F.

In severe cases the eruption is often marked in the throat and on the palate, and the mouth, tongue, and throat are dry, foul, and distressingly uncomfortable. In such cases a mild antiseptic mouth-wash, containing also glycerin and perhaps lemon juice, if used frequently as a gargle or swabbed over the parts, will contribute materially to the patient's comfort.

As *constipation* is practically always present during the entire course of the disease, a gentle laxative should be exhibited daily. Nothing serves better for this purpose than the *sulphate of magnesia* (Smith, Springer, Stewart), in sufficient doses to produce one or two daily stools.

Regardless of the fever, the nurse should be instructed to give the patient frequent sponge baths, followed by alcohol rubs, to maintain an active and comfortable condition of the skin, and the position of the patient should be changed frequently to prevent hypostatic congestion and slough formation. If the skin itches or burns, sponging with a strong soda solution, or applying an ointment of oil of eucalyptus, one part in eight parts of vaselin (Springer), will be cooling to the skin and relieve the itching.

The *heart* often shows signs of weakness and dilatation, particularly in the older patients, and this condition calls for the exhibition of *digitalis* and *strychnin*, preferably given hypodermically. Taylor advises the routine use of strychnin as soon as the pulse rate begins to rise, and continued through convalescence to support the weakened heart muscle.

Bronchitis complicates many of the cases, and in alcoholics pneumonia is liable to occur (21). Edema of the lungs is also reported as

a fatal complication (8; 22). Cases having lung complications require special care in nursing, frequent change of position in bed, and otherwise attending to the comfort of the patient and to the hygiene of his environments. The heart usually goes bad in these cases and needs constant watching. Whiskey, egg-nog, etc., may have to be given in addition to digitalis and strychnin to stimulate and support the heart, and oxygen may be of benefit in combating the carbonic acid poisoning.

Nephritis is not a common complication, but nearly all of the severe or fatal cases develop uremia, or at least a profound toxemia. Hence the advisability of encouraging all patients to drink freely of water, and also the daily exhibition of moderate doses of magnesium sulphate or other laxative. In the severe cases, if the patient's condition will permit of it, the hot bath or hot pack will be of benefit by promoting activity of the skin and relieving the overtaxed kidneys. The slow saline enemata, drop-method (Pease), or normal salt solution given subcutaneously, may be of special service.

In the Montana cases cerebrospinal symptoms are frequently encountered (Kellogg), and delirium is practically always present in the severe cases. One case is reported (21) where the patient developed an acute mania which lasted about two months after convalescence. Hydrotherapy, sedatives, and restraining measures limit the physician's usefulness in these cases.

When the eruption involves the palate and pharyngeal walls, as it sometimes does in the Idaho cases, gangrene is apt to develop and prove a serious complication, practically always fatal. In addition to the cleansing and antiseptic mouth wash suggested above, removal of the necrotic tissue may make the mouth less foul, and thus add to the patient's comfort. Gangrene of the scrotum and lobule of the ear may develop in the very severe cases, the treatment being surgical.

The early and continuous use of quinin in large doses is recommended by Anderson, Mooser, and Taylor, with the claim that it has a favorable influence on the course and severity of the disease, but this claim is not sustained by the experience of many other physicians, including the writer. In using the quinin treatment it is recommended that the sulphate be given in 1.0 to 1.32-gm. (15 to 20-gr.) doses, repeated every four to six hours. If the sulphate disturbs the stomach, the bimuriate may be given hypodermically, 1.0 gm. (15 grs.) every six hours (Anderson), or the quinin may be combined with sodium benzoate, 1.0 to 1.32 gms. (15 to 20 grs.) of the former to 2.0 to 2.65 gms. (30 to 40 grs.) of the latter per day (Taylor). Mooser gives 2.0 gms. (30 grs.) twice daily for about one week, then gradually reduces the dose until temperature remains normal. Kellogg and Reed have each used sodium cacodylate with apparent success in a single case.

The *diet* requires careful supervision from the beginning of the dis-

ease to prevent intestinal fermentation, and later to properly sustain and nourish the patient. If the bowels are kept open a fairly generous *soft diet* may be allowed most patients throughout the entire course of the disease. Milk, buttermilk, sauer milch, or Bulgarian buttermilk, kumyss, broths, soft eggs, soft toast, etc., are usually well borne and relished by the patient, and can be repeated every two to four or six hours.

SERUM TREATMENT

Serum therapy gives promise of being of real value in reducing the mortality of this disease. In 1907 Ricketts (15f; 16) used a serum which he had prepared by injecting a horse with large quantities of blood from diseased guinea-pigs. In his experiments on guinea-pigs he found this serum to have a fairly high protective power, and a moderate curative effect, when given early and in large doses. The serum was also given in various amounts to eight cases, supplemented in two of the cases by intravenous application, with an apparent slight reduction of the mortality rate, but, as Ricketts says, the number of cases treated was too few to afford a just basis for comparison. Recently Heinemann and Moore (4) have been making valuable studies along this line. They have succeeded in concentrating the horse serum, and report that their preliminary experiments on the value of immune horse serum as a curative agent are encouraging and will be continued in the near future. However, the practical success of serum therapy seems to depend on our ability to isolate and cultivate the causal microorganism, as the toxin can be obtained in no other way in sufficient quantities for satisfactory immunization of the horse.

CONVALESCENCE

Convalescence is usually established at the end of the third week, but the patient is apt to be several weeks in getting back to normal. The spots are often visible at times for many months or even years after recovery. In addition to a good nourishing diet and an abundance of outdoor air, *bitter tonics*, with *hydrochloric acid* and *iron*, should be ordered. An excellent iron preparation for these cases is irontropon, a teaspoonful in a cup of hot milk or hot water being administered after meals. This not only supplies the deficient hemoglobin, but, if taken in hot water, has a laxative effect on the bowels.

SUMMARY

To summarize, the chief features in the treatment of spotted fever are as follows:

1. Preventive measures, by avoiding exposure to infection, and the various methods for destroying ticks.
2. Initial dose of calomel and soda, followed by a saline.
3. Aspirin for pains.
4. Hydrotherapy for fever.
5. Sulphate of magnesia daily, and drink freely of water.
6. Strychnin, digitalis, and whiskey for weak heart.
7. Soft diet.
8. Bitter tonics, hydrochloric acid, and iron in convalescence.

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by the fact that the total number of autopsies on cases of Weil's disease is at present probably not more than fifteen or sixteen.

General Treatment.—The typical case of Weil's disease is markedly prostrated at the outset, and the patient should be first of all placed in quiet surroundings and given the benefit of good nursing.

Diet.—This will vary according to the amount of gastric disturbances present. The loss in weight in this disease is somewhat large, and takes place rather rapidly. In a recent epidemic a series of twenty cases was reported by Hecker and Otto, in which the average loss of weight was somewhat over seventeen pounds.

It is impossible to prevent this loss of weight by any method of feeding, and to force the food is unwise; such a forcing process would result in the overloading of an alimentary canal already badly deranged, the general toxemia would be prolonged or increased, and the course of the disease would be unsatisfactory. Let it be remembered that in those cases of typhoid fever in which a very liberal diet is employed relapses are much more frequent than when a lighter diet is used, although the weight itself is better maintained under the liberal diet. In Weil's disease relapses are frequent and possibly overfeeding may be responsible for many of them.

At the outset a large number of cases should be placed upon a liquid diet, consisting of milk, somewhat diluted, of thin soups, and tea. In rather mild cases a somewhat more liberal but easily digested diet may be allowed. Generally, however, the patient's tongue is heavily coated, there are nausea and vomiting, and there is no desire for food.

In other cases where the vomiting is severe from the outset the very best thing to do is to discontinue absolutely all food, allowing only water. The complete withdrawal of the food may be maintained from one to four days with the greatest benefit to the patient. Under this starvation the vomiting decreases rapidly and there is great improvement in the nausea. The stomach remains irritable, however, but as it is free from decomposing food the irritability plays a smaller rôle than it otherwise would. In those epidemics which seem to have been caused by meat or by some other article of food the vomiting is intense and the general gastrointestinal disturbance is so great that the cases appear as if they were ones of ptomain poisoning. For such cases there is nothing that can equal the method of starvation. It gives the best and at the same time the quickest results. In fact, actual starvation is a method of treatment that should be much more widely adopted by the medical profession in a large variety of acute conditions accompanied by vomiting or by nausea alone. The idea of giving the stomach rest when it is acutely irritated is a common one, but very few physicians carry out that idea.

Almost invariably small quantities of food, especially milk, are administered, and if the food is not vomited it is assumed that it is nourishing the patient. Even if it is vomited the food, possibly in reduced quantities, is still forced upon the patient at regular intervals. By this procedure more or less decomposition of food continues in the stomach, the nausea and vomiting are prolonged, and the general toxemia is frequently increased. In some cases of acute abdominal inflammation, especially appendicitis, the administration of even very small amounts of food is often attended by the most serious consequences.

In very many cases the gastric symptoms cease in three or four days. In these the diet may now be increased, allowing a small amount of

easily digested articles. In cases of obstinate vomiting, which continues a week or more, small amounts of liquid food must be given. If the method of starvation were adopted more frequently, such cases would probably be extremely rare.

Medication.—There are no specific remedies for the cure of Weil's disease. The treatment is purely symptomatic, and should be in accord with the general principles underlying the treatment of acute infections. We have to deal with a well-marked febrile disease in which hyalin and fatty degenerations are taking place, and a large and tender liver is present, and very frequently a large and practically septic spleen also. In view of these conditions one should act conservatively in the matter of treatment, always bearing in mind the fact that a fatal termination occasionally takes place, and also that under improper treatment convalescence may be greatly delayed or prolonged.

Probably the most satisfactory drug to use is salol, given in the dose of 1.2-2.0 (20-30 grs.) in the twenty-four hours. It usually disturbs the stomach but little or not at all, and it may be safely continued throughout the disease. For their cholagogue effects phosphate of soda or sodium salicylate may be used. The salicylate, however, is very apt to add to the gastric irritation already present in many cases, notwithstanding the reports of some that nausea and vomiting are rare, or do not occur at all. In place of the salicylate aspirin may be used, as it is better tolerated by the stomach, and also frequently acts as an antipyretic, reducing the temperature considerably in some cases.

At the beginning it is well to give a purge and empty the bowel thoroughly. It is both unnecessary and unwise to purge these patients daily with salts. For those who are being starved an enema every other day, after the initial purge, is sufficient.

The temperature seldom requires any attention. If it should remain high phenacetin or cold sponging may be employed.

The urine should be often examined, owing to the frequent involvement of the kidneys. In an epidemic occurring in Hildesheim in 1897, and embracing twenty-six cases, albumin was present in forty-two per cent. of them; in 1910 in another epidemic at the same place, with twenty cases, albumin was present in ninety-five per cent. of them. Casts and red blood-corpuscles are also frequently present in the urine, and the picture is one of an acute nephritis.

For the moderate grades of albuminuria no treatment is required. In the more severe forms, possibly with blood and casts also, the treatment is that of acute nephritis in general. Fortunately, the prognosis in this nephritis is good, and the renal condition generally passes away with the establishment of convalescence.

The various muscular pains which are almost always present frequently require attention. Those occurring in the calves of the legs

are sometimes so severe as to dominate the entire scene at the outset. For these Weil has recommended subcutaneous injections of antipyrin in doses of 0.2 (3½ grains). He states that it distinctly relieves the pain for several hours, at the end of which time the injection may be repeated.

Convalescence.—The period of convalescence should be treated, when possible, with an outdoor life, an abundance of nourishing food, and a sufficient amount of rest. Frequently convalescence is slow, extending over a period of one to two months; for these cases the very best treatment is a change of climate.

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CHAPTER XXVIII

GLANDULAR FEVER

ALLAN RAMSEY

This disease is an acute general infection of unknown origin. It was minutely described by Pfeiffer in 1889, since which time nothing new has been added to our knowledge of the subject. The disease is manifested by enlarged tender lymphatic glands, especially those of the cervical region, although the axillary and inguinal glands are very frequently involved, and it is highly probable that the bronchial and mesenteric groups are also affected. The constitutional disturbance in typical cases is considerable, there being high temperature, anorexia, and vomiting, and general malaise at the outset. All movements of the head become painful, and the neck is held more or less rigid, and on the second or third day the enlarged cervical glands can be felt.

The most marked feature in all the cases is the enlargement of the lymphatic glands. As a rule, the enlargement begins on the left side in the carotid region, and reaches full development by the end of the second to the fourth day. Generally a few hours before its completion on this side the beginning of swelling upon the right side can be noticed. Occasionally the swelling begins upon the right side, but it never begins simultaneously upon both sides. To the eye the swelling appears as a smooth elongated mass beginning at the angle of the jaw and extending downward and forward to a point somewhat beyond the middle of the jaw. The mass is about the thickness of the finger, and there is no matting together of the glands; three or four separate glands can readily be felt. They are always tender, often painful, and generally cause stiffness of the neck.

In seventy-five per cent. of the cases reported by West there was also enlargement of the post-cervical, axillary, and inguinal glands. They were not all enlarged in one and the same case, nor were they as tender as the cervical glands. He states, also, that in approximately half of his cases he could feel enlarged mesenteric glands; this has not been the experience of others, and yet, in view of the wide involvement of the lymphatic glands, it is highly probable that the mesenteric group is affected.

This disease occurs generally between the ages of three years and sixteen years, although cases occur occasionally in infants; in adults it is extremely rare. After the glands have become enlarged the diagnosis is comparatively simple.

There need be no confusion with mumps, because the parotid glands are not involved, and yet the swelling beginning upon the one side and later involving the other side gives the disease some resemblance to mumps.

As regards the origin of this disease, nothing definite is known. By some it is regarded as a streptococcic infection with the tonsils as the point of entrance, they showing at the time no apparent lesion. In nearly all cases of this disease there is a conspicuous absence of any tonsillar or pharyngeal inflammation. Upon this point there is general agreement. The constant presence of constipation led to the theory that the symptoms and adenitis might be due to infection from the intestine or to the absorption of toxins from the retained feces.

PROPHYLAXIS

In the matter of the prevention of this disease we are handicapped by our ignorance of its cause and of the special conditions which are favorable to its development. Fortunately the disease is not common and the number of cases developing at any one time is usually small. An idea of the proportions of outbreaks may be gained from the fact that several reports consist of records of five, twelve, and twenty-one cases. West's large series of ninety-six cases is very unusual, but it included cases that occurred throughout a period of four years.

As regards contagiousness, Pfeiffer long ago pointed out the fact that the epidemic character of the disease seemed to be such as to confine it to a single house or family, beyond which it does not extend. There was no connection between the families affected; they lived far apart, were not acquainted with each other, nor had they been in communication with each other. Cases would spring up in portions of a city widely separated from each other; there was no appearance of house to house infection, nor were there any outbreaks in the schools to indicate the school as a source of infection or as a medium of transmission. In fact, all evidence of any regular method of spreading the disease was entirely absent. Therefore, it is apparent that any effort to close the schools when a few cases of glandular fever develop in a community is uncalled for, and as a prophylactic measure would accomplish nothing.

When the disease does appear in a family, however, it usually attacks two or more children of that family. West's ninety-six cases occurred in forty-three families. Chapman reported that five of his own

children contracted the disease, and, in twelve cases reported by Vipond, four were in one family. Prevention is, therefore, more a question of the individual family, and a child that contracts the disease should be isolated at once.

Isolation, to be successful, requires, among other things, early diagnosis; this, however, is usually easy of determination.

TREATMENT

Most all of the cases are among children, and the digestive organs are decidedly disturbed from the onset. Until the initial vomiting is over, or nearly so, it is well to withhold all food and allow only water. When the vomiting has subsided the child should be placed upon the usual liquid diet of milk, broth, and soups. As soon as general improvement begins the diet should be increased without delay.

An initial purge should be given and the bowel thoroughly evacuated; if toxic material exists in the bowel, only good will be done by relieving it of this. It is well to give an occasional dose of calomel, and West states that he believes that the depression following the disease is not so great when calomel has been used. Nevertheless, he found that in several severe cases the use of calomel in an attempt to bring on a crisis invariably seemed to make more marked and longer continued the depression and anemia which always follow the disease.

There is no internal medication that has any marked effect upon the disease. Salol may be given in moderately large doses, and probably does good in some cases.

During the period of great discomfort and high temperature it is best to combine small doses of phenacetin with it. Salicin is said by some to relieve the symptoms considerably. Forchheimer states that in an epidemic connected with influenza he was able to shorten the course of the disease by the use of quinin.

Adenitis.—The pain in the neck may be greatly relieved by local applications. A cold compress or a small ice bag over the affected glands is an excellent measure; cold bichlorid compresses, as advocated, probably owe their virtue to the fact that they are cold. Belladonna fomentations will often alleviate the pain, and I have used a twenty-five per cent. ichthyol ointment to advantage in some cases. No local measures, however, will prevent the development of the adenitis upon the other side of the neck. Suppuration of the glands need not be feared, as this is an extremely rare event. Dawson Williams never saw it occur in any of his cases; it did not occur in West's series of ninety-six cases, and this has been the experience of many others; Schaeffer, however, saw it occur twice in twenty-one cases.

Complications.—Complications are to be treated according to their nature as they arise. The disease is singularly free from them, however. A few serious cases of acute nephritis have been observed, and epistaxis occasionally occurs. Among Chapman's own five children who had the disease epistaxis occurred in all of them, and in one it was so severe as to be very alarming. The abdominal pain which occurs in so many of the cases is not so severe as to require any special measures. In some epidemics there are mild cases which run their course in two to four days, and require little or no treatment.

After severe cases there is marked depression, anemia, and frequently considerable loss in weight. During this period an ordinary tonic régime must be adopted, and some form of iron will usually be required. The enlargement of the glands usually disappears before the end of the third week, and chronic enlargement probably never occurs. Complete restoration to health frequently requires from four to six weeks from the beginning of convalescence.

The prognosis is exceptionally good, death being a great rarity. In West's ninety-six cases there was but one death, and that occurred in a delicate child just convalescing from scarlet fever. In Seibert's twenty-four cases there was one death; in Vipond's series of twelve cases there was no mortality, nor were there any grave complications at any time.

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CHAPTER XXIX

MILIARY FEVER

ALLAN RAMSEY

This is an epidemic infectious disease of unknown origin found almost exclusively in France, Germany, Austria, Italy, and England. It does not occur in this country, and at the present time it is found chiefly in France.

The treatment of the disease will be better appreciated if its salient features are borne in mind. It is characterized by profuse sweating, an erythematous and vesicular eruption, and by a group of nervous phenomena. The onset is usually abrupt, with fever, sweating, a sense of great oppression in the precordial or epigastric region, and prostration. This feeling of oppression or constriction is one of the most prominent symptoms, and seems to be purely nervous in character. At the end of the third day or upon the fourth the eruption appears, being first erythematous, and later becoming vesicular. It appears first upon the sides and back of the neck, and then gradually spreads over the entire body. With the appearance of the eruption there is a decrease in the constitutional disturbance, and the patient feels much relieved.

The sweating constitutes the most constant of all the symptoms; it appears at the beginning of the disease, and continues throughout its entire course. The sweats are profuse and continuous, and the patient is always wet with perspiration.

About the end of the second week or in the beginning of the third week the symptoms subside, and convalescence begins. The return to health, however, is quite slow; the loss in flesh has been marked, and convalescence finds a variety of sequelæ. Some patients have edema of the lower extremities; sometimes there are fibrillary twitchings of the face, and the tongue is tremulous; there may be persistent insomnia, anorexia, and profuse perspiration after the least fatigue; cardiac arrhythmia is also present at times. The slowness and complexity of the convalescence are quite characteristic of the disease, and this is true of mild attacks as well as of average ones. Several weeks are usually required for a restoration to health, and cases have been reported in which convalescence was prolonged for twelve months.

Miliary fever is a disease that presents a great variety in its gravity. In some epidemics there are scarcely any deaths, while in others the mortality is very high. The prognosis in general must, therefore, depend almost entirely upon the virulence which the disease displays in the epidemic that may be in existence at the time.

The mortality may differ in various localities during the same epidemic, as in that of 1887, when the different mortalities were 33 per cent., 1.33 per cent., and 0. In 1893 Schaeffer reported an extensive epidemic in Aussee in a population of 5,000, with no deaths. In 1852 there was an epidemic with a death rate of 61.5 per cent. Given a severe epidemic with a high mortality, there is no symptom or condition upon which we can rely for a prognosis; under such circumstances one cannot even be sure of recovery in a mild case.

PROPHYLAXIS

A study of the frequency and character of the outbreaks of this disease in recent years seems to indicate that it is on the decline. This is in harmony with the general tendency of the checking of or decline of acute infections. Our knowledge of the various factors in the etiology and transmission of this disease is still quite meager; however, it seems to be established that those regions where the disease is endemic are damp, badly drained, or marshy. Improvements in sanitation and the drying and draining of the wet lands, both for hygienic reasons and for agricultural purposes, are probably responsible for this decline in the disease. Nevertheless, we must not forget that under the old bad sanitary conditions there were some long periods between epidemics, and the possibility of a recrudescence of the disease even under better sanitary conditions must be borne in mind.

During an actual outbreak of miliary fever the usual means of combating any contagious disease should be adopted. The patient must be isolated, his clothing and utensils disinfected, and the room must be disinfected when the disease is over. It is interesting to note that Brouardel, in an extensive epidemic twenty-eight years ago, organized a disinfecting corps which attempted wholesale disinfection by means of steam. How long a convalescent patient is capable of infecting others is not as yet known. If more were known of the method of transmission of miliary fever, it might be possible to take much more effective measures for its complete eradication.

TREATMENT

Formerly it was a popular idea among the laity, and especially with the peasantry, that it was injurious to the patient to remove his wet

clothing. Instead, his sweating was increased by adding much extra bed cover, and by excluding all fresh air by keeping both doors and windows closed, and by plying him at the same time with hot aromatic drinks. This is supposed by some of the French physicians to have been the cause of many deaths.

In the absence of any specific medication the treatment is largely that of any severe infection with marked febrile and constitutional disturbance. An abundance of fresh air should be supplied, the patient's gown should be frequently changed and a dry one put on, and the body should be sponged once or twice a day to remove all traces of perspiration and keep the patient free from odor. The diet and care of the bowels are to be regulated as in any acute febrile condition.

In many of the epidemics of this century quinin was used and was very well thought of. During the extensive epidemic of 1887 it, however, does not seem to have been used; in that epidemic hydrotherapeutic measures were employed for high temperatures, and an expectant line of treatment was adopted. For the intense nervousness in the early part of the disease sedatives may be used.

Relapses, which are very frequent in some epidemics, are to be treated like the original attacks. A relapse is seldom fatal.

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CHAPTER. XXX

FOOT-AND-MOUTH DISEASE

ALLAN RAMSEY

This is an acute infectious disease of animals which is occasionally transmitted to man. Its cause has not as yet been discovered, but it is both directly and indirectly contagious for human beings. Among the lower animals the disease prevails in epidemic form, the extent and ravages of some of the epidemics being tremendous. It occurs frequently and extensively in the European countries, but in this country it is rare. In Germany, in 1892, there were 4,153,539 domestic animals affected; the following year there were 500,342.

In man foot-and-mouth disease usually occurs sporadically, but occasionally it appears as an epidemic. Considering that the disease is communicable to man, and that the epidemics among animals are so extensive, it is astonishing that the disease is so rare with human beings.

While the specific cause of the disease has not as yet been found, the infectious material exists in the liquid contents of the vesicles, in the secretions from the ulcers, in the milk tainted by the vesicles and ulcers, and possibly in the urine and feces.

The lymph from the vesicles, when inoculated into calves, promptly produces the disease. Nevertheless, no bacteria can be found in this lymph either by the microscope or by cultural methods. The lymph can be filtered through the finest porcelain filter, and it will still retain its virulence. The virus must, therefore, belong to the ultramicroscopic, and in this respect is similar to that of such diseases as smallpox, scarlet fever, and measles. It is the most infectious and virulent toxin or virus known among animals.

PROPHYLAXIS

Prevention of this disease is of the first importance, and the prophylaxis of the disease in man is naturally closely connected with that of the disease in animals. At the present time prophylaxis among the domestic animals means chiefly the limiting and stamping out of the

disease after it has made its appearance. This requires the strictest quarantine of the infected animals, and the proper care of their meat and milk products. For the details of such a quarantine campaign one must consult works upon veterinary science.

The following illustrates much that is of interest in both the subjects of prevention and transmission. Probably the last epidemic of foot-and-mouth disease in this country occurred three years ago. In November, 1908, an outbreak was discovered among some Pennsylvania cattle. A prompt investigation of the epidemic by the Federal Government disclosed the fact that some smallpox vaccine virus, imported from a foreign country, was contaminated with foot-and-mouth disease. When this vaccine was employed for the production of vaccine in calves, the calves became infected with foot-and-mouth disease. This occurred with only one concern manufacturing biologic products; from this concern another purchased the contaminated vaccine and infected its own calves. The calves of the second firm, which were now infected with foot-and-mouth disease, were finally sold in the open market, and they started the epidemic. The calves of the first firm, after they had served their purpose for the production of smallpox vaccine, were killed by the firm in accordance with its usual custom of dealing with its own animals.

The Government immediately withdrew the licenses of both these firms, all their smallpox vaccine was at once recalled from the open market, and, by vigorous other measures also, the epidemic was promptly checked and eradicated. This one episode cost the Federal Government \$300,000.

No instance of the transmission of foot-and-mouth disease to man through smallpox vaccine has been recorded, and it is very doubtful if such is possible by the ordinary method of cutaneous vaccination.

Prophylaxis in man involves the following measures: First, measures against direct infection by contact with the disease. Those who are compelled to come in contact with diseased animals should adopt all ordinary hygienic measures, and all persons with cuts or erosions upon their hands should abstain from milking diseased cows.

The patient should be isolated as thoroughly as possible. This should be always done, even though the disease is not so contagious as many others. Among a dairy or peasant population, however, measures for hygiene and isolation are not easily carried out.

Secondly, prophylaxis is concerned with the management and disposal of milk, milk products, and the meat of diseased animals. The consumption of raw milk from infected cows is capable of provoking the disease, and is the source of a certain number of cases. The milk from these cows must be boiled before it is used; the milk is, however, so altered by the disease that it is scarcely fit for use; butter, cream, and cheese

made from these sources should not be used at all. The meat from infected animals should be boiled.

TREATMENT

The general treatment is dietetic and symptomatic, and requires no description. Attempts at a prophylactic serum are not yet successful, although Loeffler and Frosch have done much valuable work in this direction.

The chief treatment is directed to the care of the inflammatory condition about the lips and mouth; efforts should be made to give relief from the pain and to prevent secondary infection of the ulcers. This is accomplished usually by touching each ulcer with nitrate of silver; Baginsky advises the use of a one-third per cent. solution of permanganate of potash. A two per cent. solution of chlorate of potash may be employed as a gargle.

Fatalities are rare, and when they do occur they are found most frequently among children.

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CHAPTER XXXI

PSITTACOSIS

ALLAN RAMSEY

PROPHYLAXIS

The general facts connected with the etiology of this disease furnish us with the clues to prophylaxis. In 1879 and 1882 there were reports of small epidemics of a severe atypical pneumonia which was ascribed to contagion from parrots. Shortly before the development of these cases it was found that parrots had died of some acute disease in the various homes of all these patients. Many other epidemics of this disease, now known as psittacosis, were subsequently reported, and the parrot was invariably considered as the source of the infection.

In December, 1891, five hundred parrots were shipped from Brazil to the Paris market. During the voyage three hundred of these died and the remaining two hundred reached Paris in February, 1892. During that year forty-nine cases of psittacosis developed throughout the city, all being ascribed to these parrots.

In Florence in 1894, in a family in which a parrot had just died, there developed five cases, three of which were fatal. In 1898 in the Julian Venetia three cases developed in a house where two parrots had died shortly before.

In 1898 house epidemics in Cologne were reported by Leichtenstern. Without going into the details of the bacteriology of this disease, suffice it to say that as yet the specific cause of it has not been discovered. Micrococci, bacilli similar to those of chicken cholera, and bacilli belonging to the colon group have all been found in parrots that have died of this disease. In 1893 Nocard isolated a bacillus belonging to the colon group, and he regarded it as specific, but examination by others of both parrots and human beings who have died of psittacosis failed to show this organism.

In fact, the exact relationship between the disease of the parrot and the illness of the people in the same house has not as yet been determined. Warthin states that "the bacteriology of psittacosis and the true relations of the parrot disease to the atypic pneumonia seen in man are yet

to be definitely determined." Although he could not absolutely prove it, Leichtenstern believed that the cases reported by himself were due to infection from parrots.

A glance at the parrot business will prove instructive and will throw light upon both the dissemination and prevention of psittacosis. The business is a large one, and thousands of parrots are brought annually, especially to the markets of Italy, Germany, and Paris.

One firm advertises that it actually imports 80,000 of these birds annually. The death rate among them, however, is enormous, and within six weeks of their importation large numbers of them die. Of five hundred purchased in Brazil for the Paris market, three hundred perished during the voyage, and in all probability many of the remaining two hundred died shortly afterward in the parrot emporiums of the city.

The cause of this high mortality lies probably very largely in the filthy and unsanitary conditions under which the parrots are kept when they are brought into captivity. They are taken from a state of perfect health and transported in a badly ventilated vessel; their cages become soiled with their own excreta, and in a short time are in a filthy state. Enforced captivity under these conditions kills many of them while on the ship. But these conditions continue in a great measure in the city emporiums, so that within five or six weeks after their importation very many more of the birds have died. What the specific virus that kills them is, as has already been stated, is still unknown. The infection may originally have been confined to the ships, but it has now become endemic in the various places where the parrots are landed. Many healthy birds that are brought to the shops and emporiums soon become infected and die.

Under natural conditions the parrot is a hardy bird, and some varieties of it live to the remarkable age of seventy and even ninety years. Moreover, they thrive in captivity when they are well taken care of, and when rationally treated they will live even in confinement for fifty or seventy years.

It is, then, under conditions of filthy cages and bad hygiene that the high mortality of imported parrots occurs. In view of these facts, it would seem that cleanliness and good hygiene should be the basis of prophylaxis. All cages should be kept clean and the infected ones should be steamed or scalded, as an ordinary cleaning will not destroy the virus. The dead parrots should be burned. Periodic government inspection of all shops and emporiums where parrots are sold has been advocated, so that dirty or infected shops might be closed until they were cleaned or disinfected. This government inspection has yet probably not been adopted by any city or country.

In 1897 an outbreak of fourteen cases occurred in Genoa and a few in Florence. Believing that the parrots were the source of the disease,

the Genoese Town Council, acting upon the advice of their medical adviser, issued a circular prohibiting the keeping of parrots in private houses.

In the province of Undine similar measures were adopted. This is interesting as showing a rational attempt at prevention, but, as the outbreak in Genoa comprised only eight cases, and as other outbreaks or epidemics have always been small, it is impossible to draw any conclusions as to the prophylactic value of the edict of the Genoese council.

TREATMENT

This is purely symptomatic. The disease has a bad prognosis, as the mortality is about 35 to 40 per cent. The probabilities are, then, that, in view of this high mortality, symptomatic treatment accomplishes but little.

The patient should be placed in a well-ventilated room, and, in the present state of our knowledge upon the subject, it is best to isolate him. A liquid diet should be instituted and maintained throughout the period of anorexia and high temperature. As soon as the fever declines and the state of the digestive organs will permit, the diet should be somewhat increased, as many patients are very weak, and their strength should be kept up as much as possible by a nutritious diet.

In those cases in whom constipation is present an initial purge should be employed, after which use may be made of an enema. In many cases it is probably well to use a purge again once or twice in the course of the disease.

For high temperatures cold sponging may be employed; usually, however, high temperatures are of short duration and seldom require any vigorous treatment.

The actual treatment of this disease is purely symptomatic, and there are no drugs that influence its course or duration. Internal medication is chiefly that of stimulation, for which any of the stimulants may be used. The infection is generally a severe one, and sooner or later supporting measures are indicated in a great many of the cases. I know of no cases in which the cold, fresh-air treatment has been tried, as in ordinary lobar pneumonia. As the pneumonia of psittacosis is usually lobular, the fresh-air treatment would probably accomplish nothing.

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II. THE INTOXICATIONS

CHAPTER I

ALCOHOLISM

A. D. BLACKADER

For the strains and burdens of life all are not equally equipped. To the observer's eye the burdens often weigh heaviest on backs ill fitted to bear them, the strain presses most severely on nerves which inheritance or environment has unfortunately rendered weak and hypersensitive. It is only human that relief should often be sought through draughts which promise increased power and potions which temporarily benumb pain and banish fatigue and care.

It is not infrequently stated that civilization has increased the burdens of life and multiplied the cravings for pain-relieving and care-benumbing drugs, that inebriety is a vice of civilization; yet it must be remembered that disappointment and defeat, strain and pain, have been the lot of mortals through all time, and savage and civilized men alike have ever been ready by the use of narcotics to drown care in fantasy and enter through the gates of ivory into the realms of a temporary bliss. And the question will arise, where is the harm? Why not make use of "the subtle alchemist that in a trice life's leaden metal into gold transmutes"? The answer must always be to point to the results which follow. While even the most cautious and thoughtful physician will not hesitate to use a narcotic as a gift of the gods to relieve a life-crushing pain and give ease to those for whom all hope of life is gone, all must recognize the enthralling nature of these narcotics if used for slight, frequently recurring, and ever-present conditions of distress.

Food to the hungry strengthens life, sleep and joy refresh the wearied for new adventures; but for the depressed habitually to resort for relief to either alcohol or opium benumbs the higher faculties, engenders an ever-increasing craving, and gradually destroys the desire and the power for effort, while at the same time it diminishes the capacity for happiness, and if persisted in makes a total wreck of both soul and body.

By the Saxon and the Celt alcohol is the most frequently employed

intoxicant; it is the most easily obtained and the most palatable, and produces the greatest amount of good-fellowship and sensuous excitement. Eastern natures with their more lethargic temperament generally prefer the dreamy languor produced by the poppy.

VARIETIES OF ALCOHOLISM

Intoxication by alcohol may be acute, chronic or periodical.

ACUTE ALCOHOLISM

Acute alcoholism is met with occasionally as the result of some unusual conviviality in individuals who seldom use any spirituous liquors. More frequently it is the result of an excess in persons who make use of stimulants moderately but more or less habitually.

The amount of alcohol required to produce symptoms of intoxication varies much with the individual. In some a peculiar susceptibility to its action is met with, so that a small amount induces severe or unusual symptoms. The effects also vary in different individuals, so that under its influence one becomes sentimental, another bellicose, while a third is rendered stuporous.

A very special susceptibility to its action is met with in individuals who suffer from any hereditary defect in the nervous centers arising from alcoholism in the parents. In such even a small amount may in some instances lead to a condition resembling temporary insanity, with violent excitement assuming in a few cases a suicidal or homicidal tendency.

The toxic effects of alcohol are more promptly developed and are more injurious when it is taken "neat" than when taken well diluted; when taken on an empty stomach than when taken after a full meal; and when taken by persons of sedentary habits living in the city, as compared with active individuals leading an out-of-doors life in the country.

When a large amount of strong spirits is taken within a short interval of time, especially if it has been taken on an empty stomach, the individual passes promptly into a deep, torpid sleep ending in total unconsciousness. The heart's action is weakened and the vasomotor center depressed. If unconsciousness lasts more than ten or twelve hours recovery almost never takes place (Cushny, 13). Convulsions may occur in a few instances, although very rarely in an intoxication with pure alcohol. The presence of absinthe in the liquor drunk, or a contamination by furfurol, or one of the other alcohols, is generally the determining cause. In epileptics a drinking bout may act as an excitant.

Ordinary cases of alcoholic intoxication in persons whose general health is normal recover with time, and may demand no special treat-

ment. All comatose conditions require watching. In cases seen shortly after the ingestion of the liquor the stomach should be promptly emptied. This may be accomplished by introducing a full-sized tube and running through it a weak alkaline (sodium bicarbonate, gm. 5, water L. i.) or normal saline solution at a temperature a little raised above blood heat. If this maneuver is not possible, free vomiting may be induced by a full dose of powdered ipecacuanha (gm. 1-1.3) mixed in a small cupful of warm water and taken at one draught. When vomiting once sets in it should be encouraged by copious draughts of tepid water. By many physicians, however, apomorphin hydrochlorid given hypodermically is preferred. Care, however, must be exercised to obtain a pure and unchanged salt, of which a one per cent. solution must be freshly prepared. Ten minims of this given hypodermically with 1/30th grain strychnin sulphate produces prompt emesis, which is followed as a rule by a short sleep from which the patient awakes refreshed. In patients who are violent or delirious apomorphin in a somewhat smaller dose (m. vi. to m. viii of the above solution), combined with strychnin, almost invariably quiets the delirium and secures sleep. Should convulsions occur they must be controlled by the cautious administration of chloroform.

In those cases where time is of importance repeated cold affusions over the back of the neck generally restore tone to the weakened cerebral vessels and promptly sober the individual. Von Jaksch (52) recommends a hot bath to be given previous to the affusion, but this will in most cases demand more voluntary effort than the patient is able to exert. For those who have still command of their legs a Turkish bath proves an excellent eliminating agent, and the rub down followed by the cold spray is a powerful and very sobering tonic.

For the vasomotor depression and weakened nerves strychnin is one of our best drugs. To obtain prompt effects it should be given hypodermically in doses of from 1/40-1/20 of a grain. Potassium bromid in full doses (grs. xl-lx), in a small tumblerful of water, has been recommended for the severe headache which so frequently follows a drunken bout. Perhaps more effective is caffein, given either hypodermically or by the mouth (grs. ii-iii of the pure salt, or grs. v-x of the citrate). As soon as possible a thorough evacuation of the bowels should be obtained, preferably by means of a mercurial followed by a saline draught. Five grains of calomel with ten grains of sodium bicarbonate should be given in a cachet and followed in four or six hours with an effective dose of Rochelle salts or magnesium sulphate.

For the gastric irritability which almost invariably follows a debauch a mixture containing sodium bicarbonate with nux vomica forms our best corrective. Should the condition be one of atony, strychnin, with or without a mineral acid, and combined with capsicum and with an aromatic bitter, will give good results.

CHRONIC ALCOHOLISM

Chronic alcoholism in all its stages is regarded by some as a disease; in a large percentage of cases it certainly is an outcome or manifestation of a diseased state, although in not a few it appears to be merely the result of an insidious enthrallment of the individual by a vicious habit. Statistics show that in the majority of cases some constitutional defect underlies the condition. In this constitutional defect alcoholism in the parent plays an important part. Kerr states that it was present in fifty per cent. of his cases; Crothers (12) places the percentage in his cases at 80, while Francis Hare (22) at the Norwood Sanitarium in England, states that, out of 271 cases that have passed through the institute during the past three years, 153 had a direct history of alcoholism in one or both parents, in 28 the heredity was doubtful, while in 90 it appeared to be quite absent. The manifestations of this tendency to alcoholism, handed down from parent to child, are very variable and often indefinite. In many the tendency appears to be due to a vicious early education rather than to any distinct mental or constitutional defect. In a large number, in addition to the unfortunate training in childhood, we meet with a definite condition of neurasthenia with hypersensitive and easily exhausted nerve centers and a craving for stimulation of every kind. In a few we have to deal with a defective mental organization.

Certain forms of disease appear to predispose to inebriety. Severe injuries to the head and occasionally sunstroke may cause in a few cases permanent mental change, manifesting itself in an increased susceptibility to the action of alcohol and a lessened will power; so that an appetite for the narcotic rapidly develops. Many disturbing local disorders are temporarily improved by the employment of alcoholic drinks. In many gastralgias; in attacks of sudden faintness; in the many obscure aches and pains of neurasthenia; in neuralgias, and especially in the recurring menstrual pains of women, the relief afforded by alcohol is often immediate and peculiarly grateful, so that the habit of having recourse to it and finally depending on it is readily formed, and may gradually develop into an overmastering craving.

Even in individuals of normal tone a condition of prolonged overstrain with insufficient rest may induce a resort to the use of alcohol with the hope of obtaining strength for the daily routine of work. Business losses, marital infelicity, and great sorrows in the hypersensitive all crave the temporary relief afforded by alcohol, a temptation which if frequently yielded to will lead insidiously to the formation of a habit, and in time may develop into actual inebriety.

Social customs, association with those who habitually drink heavily, and the reprehensible habit of "treating" met with in clubs and restaurants play also an important rôle in the etiology of alcoholism. Many

occupations appear also to predispose to it, preëminently those which have in any way to do with the retail liquor traffic.

Statistics show that the appetite for alcohol is generally acquired before the age of 35 and when absent previously rarely develops into inebriety after the age of 50.

In our treatment of alcoholics we have to recognize several types. There is a large class of constant drinkers who daily take an injurious amount of alcohol. In time more or less tolerance is acquired, so that the effects of the alcohol are only to a slight degree manifest upon them. They seldom, perhaps never, become inebriated, but they cannot stop their daily allowance without feeling a distinct craving. At once their nerves become unstrung, their hands tremulous, and their spirits depressed. In time the injurious effects of alcoholism appear, of which the most important are chronic congestion and catarrh of the pharynx, chronic gastritis, chronic degenerative changes in the liver, chronic pancreatitis, and chronic nephritis. Associated with these local conditions we meet with a diminished resisting power to infections of all kinds. A severe shock or an attack of pneumonia in the more advanced cases may precipitate the development of delirium tremens. The history of this class is as a rule a progressive one, the craving and the quantity daily required gradually grow while the toxic effects of the alcohol become increasingly manifest, especially in an impairment of mental vigor. Memory becomes defective, the will power is markedly weakened, and the emotions easily excited. At the same time, the moral nature becomes blunted and the sense of responsibility in the family and to the community is lost.

PERIODIC ALCOHOLISM

Closely allied to the preceding is another class whose drinking is more or less periodic. It is always difficult for such persons to drink in moderation, and any yielding to the narcotic appears to develop an irresistible craving for more, which is only cut short by gastric irritability, physical causes, or treatment. The development of the bout appears to depend almost wholly upon chance circumstance, so that there is much irregularity both in its length when once it develops and in the duration of the more quiescent interval. Here also the condition is a progressive one and especially so under conditions where restraints are few. Nevertheless it is generally conceded that paroxysmal drinking gives rise to less injurious results than the constant drinking of the previous class, and a cure may in many instances be effected.

This class requires to be carefully distinguished from the third class, that of the true periodic dipsomaniacs, in whom an invincible craving precedes the drinking bout, a craving which recurs with almost as much regularity as an epileptic attack. Before the bout sets in a premonitory period of restlessness and irritability, varying in length from one to sev-

eral days, is always to be noted. Once the bout is commenced enormous quantities of alcohol may be taken, sometimes with a great degree of tolerance. After the bout is over, a period of abstemiousness without desire for liquor ensues, generally of some months' duration. Alcoholism in these cases appears to be the symptom of a nerve storm in some degree resembling epilepsy in character, but of which the etiology is uncertain. The attacks are often associated with a complete change in character, mentally and morally, the individual becoming almost the antithesis of what he was when sober. In some of these cases an absolute lapse of memory may occur, and when the patient recovers he may be quite oblivious of everything that occurred during the interval. In a few cases the alcoholic loses his orientation, misinterprets the conditions of his environment, and may become very excitable. Instances are also on record where such an individual has started off on a long journey and only come to himself in a distant city, with no recollections of the intervening period. In this class of alcoholics it is very evident that we have to deal with a deep-seated neurosis which, while undoubtedly aggravated and rendered more permanent by alcohol, has a different etiology to that of pure alcoholism and requires a treatment corresponding to its etiology.

PROPHYLAXIS

Much may be done by the state, by parents, and by the medical profession to prevent the development of alcoholism. While we recognize that at the demand of public opinion the majority of governments at the present day limit the number of saloons in a district, and the hours during which they may remain open for the sale of intoxicating drinks, it is probable that in the future a much greater limitation will be demanded. Temptations to drink should not beset the weak at every corner. With a high license fee, with the number of saloons limited, and with the hours shortened at which intoxicating liquors may be sold, much needless temptation may be removed. The advantages accruing from the absolute prohibition of the sale of intoxicating liquors in any city, county, or state must still be regarded as dubious, but extensive farm colonies might be established in every state where outdoor employment of all kinds could be obtained at a living wage for those who found themselves unable otherwise to withstand the temptations of the saloon.

In public schools the older scholars should be taught the injurious action of alcohol on the system, its interference in the normal individual with judgment and with the capacity for work, and its insignificant value as a food compared with the price paid for it.

Still more important is the education of the child in its home. The parent who gives way to every caprice of a child favors the insidious growth of uncontrollable impulses in the youth; the child with the means

to supply every wish of its appetite develops a habit of self-indulgence which grows; self-control is dwarfed and the gratification of the sensual tastes and passions becomes in time a dominating impulse. Idleness also in the young, due to lack of healthful recreation and amusement, encourages vice, prevents the development of a resourceful activity, and favors a craving for stimulation of all kinds. To counteract many influences over which at the present we have no control, Froebel has shown us the great possibilities in character building which exist in play and which may be exerted on the child by a judicious development of the playground. Justice, self-control, forbearance, prudence, and perseverance may all be cultivated so as to become strong barriers in after-life against the development of excesses of all kinds. Much also may be accomplished in securing for the working classes, with their crowded and too often uncomfortable homes, healthful places of amusement and recreation where at small expense pleasure, and perhaps a certain amount of education, may be obtained. Unhappy consequences must always result to any family or community whose chief resort for evening entertainment is the gin palace.

The medical profession to-day is also exerting a strong influence by pointing out the injurious effects of alcohol on the system when used in any excess; by emphatic warnings in all cases where any tendency to excess is noted, and by manifesting much caution in prescribing alcohol medicinally.

TREATMENT

The treatment in all cases must be based on the conditions actually present in the individual, after a careful study of the history preceding and leading up to the addiction. It is to be borne in mind that we have to deal with (1) the existing intoxication; (2) the craving for alcohol as soon as its withdrawal is commenced; (3) the circulatory and nervous depression closely associated with the craving; (4) the local disorders which have arisen from the irritant action of the alcohol, and (5) the underlying conditions always present, such as constitutional defects of a physical, nervous, mental, and emotional character, social and business habits, and the patient's environment at home and in the office, workshop, or club. In his treatment of the individual case the physician must bring to bear every remedial-influence within his powers; routine measures with stock prescriptions and a few weeks' residence in a hospital or sanatorium are not all that is required to ensure final success. The physician must be at all times sympathetic and full of hope, and instil his patient with confidence in the final result if he perseveres. In all these patients there exists a very depressing sense of mental weakness and a consciousness of lack of power in self-control. No true cure can take place until this is overcome. The influence of continued confident suggestion by the phy-

sician will prove a definite force. "Persistent and properly directed intentional thought, with an increasing conviction that failure is out of the question, can with the physician's guidance and assistance charge the patient's brain like a storage battery and develop determination into an efficient controlling idea" (Jennings). The pledge, taken under the influence of a sympathetic dominant mind, has thus in many instances been effective, and when tactfully used the influence and moral suasion of a loving wife, or of business friends, and in many cases of the church, may prove of great assistance; irritation, however, must be carefully avoided.

For the cure of the addiction and the removal of the craving for alcohol many plans of treatment have been recommended from time immemorial. The whipping post and the jail for the poor, change of climate and of scene for the rich, change of diet and of occupation for other classes have all been recommended and doubtless all have done good in some instances, for there is no treatment that will not meet with some success, and the best treatment will have a certain percentage of failures. Forcible restraint with the absolute interdiction of all forms of liquor has frequently been urged and tried. Although it may be true that with a proper dietary the craving for alcohol may in great measure pass away by prolonged detention in a place where abstinence is enforced, nevertheless a suppressed feeling of resentment against everyone connected with the interdiction is generally engendered, which effectually prevents the development of any determination to abstain in the future and still further dwarfs the power and the desire for self-control. The majority of those treated in this way take the first opportunity of again indulging, and not infrequently their first night of freedom is celebrated in the bar-room.

More successful results may be obtained in a properly arranged sanatorium into which the patient enters with his free will and with a determination, perhaps weak at the outset, to obtain freedom from his addiction. In many of these reliance is placed almost entirely upon the restorative effects of rest, massage, hydrotherapy, and careful feeding, with a moderate use of strychnin should symptoms appear to demand it. The patient is treated as one suffering from a severe neurosis. The alcohol is withdrawn more or less promptly, and during its withdrawal the patient receives the benefit of the sedative and tonic effects to be obtained from the use of hot and cold baths or packs and sprays. For the first few days complete rest in bed in a quiet, well-ventilated, and more or less darkened room is ordered and a simple nutritious dietary, suitable to the patient's digestion, is given at regular intervals day and night. General massage is commenced gradually. As strength returns and the craving for alcohol subsides an effort is made to keep both mind and body pleasantly occupied. Graduated exercises are enjoined, and, as improvement takes place, cricket, golf, and tennis are permitted, but care is taken to avoid fatigue. Regular hours of rest are imperative. Before

the patient resumes his ordinary occupation a long holiday with complete change of environment is generally necessary. To be successful this plan of treatment demands several months; in severe cases a year or more. It also demands the constant attendance of an alert, sympathetic friend, preferably a physician, with a strong personality and much tact and perseverance.

A method involving much less time and with a percentage of cures quite as large as the previous method depends on the careful employment of full doses of atropin combined with strychnin, according to the plan used first by McBride (37) and afterwards by Francis Hare (22) in the Norwood Sanatorium near London, England. As soon as practicable after the patient enters the institution, a mercurial purge containing five grains of calomel with an equal amount of sodium bicarbonate is administered and followed by a full dose of Rochelle salts or magnesium sulphate. After this has acted, the patient is placed at once on the special treatment, for which the directions are given below. In those cases in which the patient is very uproarious at the outset a hypodermic injection of apomorphin (gr. 1/20-gr. 1/10; gm. .003-.006) is given as directed, combined with strychnin (see Acute Alcoholism). This will bring on a feeling of nausea, generally followed in a short period by a light sleep. Should it fail, the injection may be repeated in a smaller dose in one or two hours, or a full dose of one of the hypnotics, with the exception of chloral, whose toxic action on the heart muscle is to be feared, may be administered. The patient's alcohol is stopped as rapidly as possible; how rapidly must be decided by the condition of the patient, and by the tolerance his system has acquired for it. An allowance of from four to eight ounces of spirits on the first day, and about half that amount on the second day is generally ample. When given it is as a rule best given with food. Too abrupt interdiction of the alcohol may in confirmed drinkers precipitate an attack of delirium tremens.

As soon as the purge has acted freely on the bowels the patient is placed upon the following tonic:

R

Ext. cinchonæ fd.....	f.	3ii
Ext. gentianæ fd....	f.	3iii
Ext. rhei fd.....	f.	3ss
Ext. capsici fd.....	m.	xv
Sol. atropinæ sulph. (gr. i-3i).....	m.	xxiv
Sol. strychninæ nitrat. (gr. iv-3i).....	m.	xxiv
Glycerinæ.....	f.	3i
Aquæ chloroformi ad.	f.	3vi

Misce.

3iv in half a glass of water at first four, afterwards three, times a day.

In addition to this mixture the patient is given hypodermically a mixture of strychnin and atropin. McBride's directions are as follows (37): Four grains of strychnin nitrate are to be dissolved in one ounce of sterile water and kept in a sterile bottle. One grain of atropin sulphate is to be treated similarly. The sterility of both solutions must be absolute; and the hypodermic injections should be given three times a day, generally immediately after meals, but care should be taken that the tonic and the hypodermic are not given too closely one after the other. The dose of the strychnin solution begins at two minims, of the atropin solution at one minim; both are increased by one minim every second or third day till the dose of strychnin reaches a maximum of five minims and the dose of atropin four minims by the end of the first week. During the second week the increase in the dose must be very gradual and must be carefully watched. Hare states that it may be increased to a maximum of seven minims of the strychnin solution and six of the atropin solution. This amount will require careful watching. McBride recommends that the atropin be increased cautiously until well marked physiological effects are produced; namely, dry tongue and dilated pupil. Only rarely is it necessary to push it to the extent of producing delusions, although McBride states that by doing so the anti-alcoholic effect produced is stronger and that in some of the more severe cases this action of the drug may be necessary. The delusions, however, entail a considerable amount of work on the attendant staff.

The diet for the first few days should be liquid, nutritious, and easily digested. Milk in all its forms, cereal gruels, broths, beaten eggs, and a moderate amount of tea or coffee may be given. Food at this period should be given, according to the amount taken at a time, every two or three hours during the day, and also during the night if the patient is not asleep. As the conditions improve, semi-solid and finally solid foods may be allowed at longer intervals. With many patients there is a distinct craving for fruit, of which the more digestible kinds may be allowed freely; oranges, lemons, grapes, apples, and watermelons have all been recommended at different times as aiding in the cure of the drink habit, and in certain conditions of the stomach, with a dry, furred, or leathery tongue, the acid of many fruits is extremely grateful. During the whole period of treatment the diet should be carefully arranged to suit the patient's digestive powers, which should not be overtaxed.

By the beginning of the third week, if the progress of the patient has been satisfactory, the dose of atropin may be rapidly reduced and may be altogether omitted after the sixteenth day. The following week the atropin may be withdrawn from the tonic mixture and the amount of strychnin given hypodermically may be reduced. By the fifth week the hypodermics of strychnin may as a rule be stopped. The patients, in the large percentage of cases, lose all desire for alcohol after five or six days

and will of their own accord cease drinking. Sleep will become more natural and the appetite will return. By the end of the second week the nervous depression will have entirely disappeared, and with an honest desire on the part of the patient to give up the use of alcohol his progress for the next few weeks should be steadily maintained. In a few cases, however, and especially in patients who are only half-hearted about their cure, the results are less successful. In some of these cases a hypodermic injection of apomorphin, gr. 1/20-1/15, given two or three times just before the patient is permitted to take some alcohol, may have happy results.

Closely resembling this plan of treatment is the method recently given to the profession by Dr. Alexander Lambert (34), of the Bellevue Hospital, New York, and known as Town's specific treatment for the obliteration of the craving in morphinism, cocainism, and alcoholism. The following are the special directions for the cure of alcohol addiction: "In the treatment of alcoholics the same specific is used and in the same dosage as in opium addiction, but it does not need to be continued for so long, although there may be some exceptions. Some closer observation is necessary, as the alcoholic is more prone to show a slight delirium from belladonna than are the patients who use morphin or cocain, and often a good deal of shrewd observation is necessary to differentiate the beginning of belladonna delirium from the ordinary delirium of alcohol. The former may generally be distinguished by being less furious and having fewer but more persistent ideas, usually only one or two. The hallucinations of alcohol are usually those of an occupation delirium, and are very various, following each other quickly. If belladonna delirium occurs the specific should be discontinued till it disappears, when the specific should be begun again with the original dose. When an alcoholic is admitted in the midst of his spree or at the end of it, the first thing to do is to put him to sleep, and the only medication which precedes his hypnotic are four or five freshly made compound cathartic pills (U. S. P.)." The hypnotic which has given the best results in Lambert's hands is the following:

\mathcal{R}	gm. or c. c.	
Chlorali hydratis	1.	gr. xv
Morphinæ sulphatis .....	.008	gr. $\frac{1}{8}$
Tincturæ hyoscyami	2.	3ss
Tincturæ zingiberis .....	.6	m. x
Tincturæ capsici .....	.3	m. v
Aquæ, ad.....	15.	f. 3iv
Misce, fiat haustus.		

This should be given in half a tumblerful of water, and if not successful may be repeated in an hour's time, with or without one or two

drachms of paraldehyde. If these are not effective within two hours, and the patient's delirium is of the furious, thrashing motor type, a hypodermic injection of the following will almost invariably quiet him.

R	gm. or c. c.	
Strychninæ sulphatis .....	.002	gr. 1/30
Hyoscyaminæ sulphatis .....	.0006	gr. 1/100
Apomorphinæ hydrochloridi .....	.006	gr. 1/10
Aquæ destillatæ.....	1.	m. xv Solve.

"If the patient has been very hard to put asleep and needed all these hypnotics, he may be allowed to sleep until he wakes naturally before beginning the specific. If, however, he goes to sleep easily with the chloral and paraldehyde, it is safe to wake him every hour for his specific, as he will quickly drop off to sleep.

"The specific in this treatment is the old 15 per cent. tincture of belladonna combined with fluid extract of xanthoxylum and fluid extract of hyoscyamus in the following proportions:

R	
Tincturæ belladonnæ, U. S. P., 1890.....	c. c. 62 f. ʒii
Fluid-extracti xanthoxyli, " 1890.....	
Fluid-extracti hyoscyami, " 1890..	āā c. c. 31 f. ʒi
Misce.	

"Begin the treatment by giving every hour six to eight minims. Every six hours increase the dose by two minims until 14 or 16 minims are taken every hour, or until signs of belladonna intoxication manifest themselves."

In addition, Lambert believes it wise to give most alcoholics 1/60 to 1/30 of a grain of strychnin every four hours. In the robust alcoholic this may not be necessary, but in the majority of cases it is more often indicated than not.

Fourteen hours after the beginning of the specific the patient should again be given a cathartic. From the severity of the action of the preceding dose one must judge whether the same dose be repeated, or whether only two pills be given along with five grains of blue mass. Care must be taken not to over-physic. Patients in a weakened and poor physical condition should have with their milk one or two ounces of whiskey four times a day for the first day and about half that amount during the second day, after which it is as a rule not wise to give any more. In young and robust individuals, with the aid of a second dosage of the hypnotic, it is possible to carry out the entire treatment without the use of any alcohol.

If after the second dose of the cathartic the patient should show the characteristic green mucous stools he should be given an ounce of castor oil, as described in the article on opium addiction. If, however, the

green stools do not appear at this time more cathartic pills should be given until they do appear, then the oil is given and after it has acted in the characteristic way all the specific treatment will cease.

The craving for alcohol should by now have vanished, but such vigorous elimination will produce a considerable amount of relaxation. A good vigorous non-alcoholic tonic is demanded, which should be given at regular intervals. It may be advisable also, if sleep is not secured naturally, to administer as a hypnotic 15 or 20 grains of trional for two or three nights. This treatment, to ensure the best results, should be carried out in a hospital or sanatorium where the patient can be carefully watched by a capable attendant. Lambert emphasizes the necessity of a conscientious adherence to its many details if success is to be obtained. Regarding the method he writes as follows: "This treatment is not an infallible cure for alcoholism, for there is none such short of the grave. It does, however, obliterate the craving and establishes the patient's self-confidence to go on without alcohol. It will do all that can be done for the man that honestly desires to be helped; but as sure as that man lives, and just so long as he lives, he cannot touch alcohol in any form whatsoever without danger of a relapse."

This statement is true of all the different methods for the treatment of alcoholism, therefore in every case the patient should receive all possible assistance from friends and from his physician in the prolonged struggle that he must make against old habits and old associations. Every local disorder that may prove a source of weakness or irritation should, so far as possible, be treated and removed. This is especially true of all forms of gastric irritability, and a weekly visit to the physician's office for inspection and treatment is not too much to be demanded for some months. At these visits the physician should keep a careful watch on the condition of all the digestive and eliminating organs. Overstrain of all kinds should be forbidden, regular hours of rest enjoined, and such nerve tonics prescribed as may at the time be deemed desirable. Should at any time symptoms of nerve strain manifest themselves, a short holiday with complete change of scene and environment should be ordered. The patient who after a few weeks' treatment in hospital returns to an insanitary, uncomfortable, and often unsympathetic home, and is thrown again among evil associates and can obtain only occasional labor, will be more than human if he withstands the temptation again to indulge. In Great Britain a society has been formed, termed The Inebriates' Reformation and After Care Association, the members of which endeavor on the return of such a patient to improve any faulty condition existing in his home, to secure for him the assistance of sympathetic friends, of visitors from the church to which he belongs, and of members of temperance fraternities. It is hoped that in this way the psychological treatment begun in the hospital may be continued as long as may be necessary.

While overstrain in all these cases must be carefully avoided, the importance of methodical occupation for mind and body must not be overlooked. The amount of depression occasioned by having nothing to do is frequently underestimated.

A few years ago the Keeley Gold Cure for the treatment of alcoholic addiction received a great deal of attention from the daily press. Unquestionably a large number of temporary cures were made, and in a few cases these patients had sufficient strength of will to remain ever afterwards total abstainers. This method of treatment appears to have depended chiefly upon hypodermic injections of strychnin and atropin given four times daily. In addition to these injections the following tonic was given at two-hour intervals:

R		gm. or c. c.
Auri et sodii chloridi.....	gr. i	.06
Ammonii chloridi	gr. xxiv	1.65
Aloin	gr. i	.06
Fluid-extracti viburni	f. ʒiv	15.
Tincturæ cinchonæ	f. ʒii	60.
Glycerin	f. ʒi	30.
Aquæ, ad.	f. ʒvi	240.

Misce, et signa.

One dessertspoonful in a wineglassful of water every two hours.

In addition to the drug treatment, hot and cold packs, sprays, douches, and baths were used freely for their eliminating, sedative, and tonic effects. Suggestion took a prominent place in the cure. Patients remained for one month in the institute. The percentage of cures was stated to be over 60.

Hypnotic suggestion is another method which from time to time has had its advocates. It appears to have some value in selected cases, as most alcoholics are good hypnotic subjects, but to insure success the patient must have a real wish to be cured, should be placed under favorable conditions while undergoing treatment, and should be kept under supervision for at least a twelvemonth.

Under a careful man this method has the advantage of promptly conferring some mental assistance, and of permitting the patient to attend to his business, and thus saving him from loss of time and from the demoralization of enforced idleness. Hypnotic or mental suggestion should aim at increasing the patient's power of control and the restoration of his self-respect. Dr. Milne Bramwell states that out of 76 cases of chronic alcoholism that passed under his observation and were treated by hypnotic suggestion 28 were cured, 36 benefited, and only 12 failed to respond favorably to the treatment. Doctor Bramwell's statistics, however, are unusually favorable.

In the treatment of true *dipsomania* very little can be done during the intervals. Any defects which may be detected in metabolism should, as far as is practicable, be remedied; local disorders should be carefully treated, and care should be taken to ensure that the patient's life is carried on under the most perfect hygienic conditions obtainable. During the attack absolute restraint in hospital or sanatorium is of great value when it can be obtained. Francis Hare states that small doses of apomorphin (gr. 1/30; gm. .002) given hypodermically will still the craving for alcohol for some hours, and is more efficient than either strychnin or atropin. The dose produces a slight pallor with an evanescent sense of nausea, and is soon followed by sleep, after which the dose may be repeated as may be deemed necessary. If thought desirable strychnin may be associated with it in the same injection. Rolleston (45) considers that the symptoms in many of these cases are suggestive of thyroid insufficiency, and recommends a prolonged course of thyroid extract. He claims that marked improvement has occurred in some cases during its administration. Many cases must be regarded as a form of insanity and therefore demand treatment in an asylum.

For the treatment of the many local or systemic disorders which may arise as a consequence of the action of alcohol as a protoplasmic poison we must refer the reader to the detailed treatment of each disease in other parts of this system. The only complications to which we shall make special reference are delirium tremens, acute hallucinosis of drunkards, and Korsakow's psychosis.

DELIRIUM TREMENS

In regular drinkers who daily take an injurious amount of alcohol, and especially in those with an hereditary tendency to alcoholism, insanity, or other manifestation of neurotic instability, any acute alcoholic excess may bring on an attack of delirium tremens. Its development is generally regarded as in great measure due to the prolonged and toxic action of alcohol on the nerve centers, but it is also very dependent on an impoverished nutrition of the cells of the gray matter in both brain and cord. It is much more frequently met with in those who consume spirits than in those who habitually use wine or beer. The previous duration of chronic alcoholism is said to be never less than six or seven years. A few cases are reported, however, in which an attack of delirium tremens has developed as the result of a prolonged bout of hard drinking in a neurotic individual who was said to have been previously abstemious.

An attack of delirium tremens may also be precipitated in a steadily heavy drinker by any sudden depressing shock to the system. In such individuals acute traumatism of all kinds, and especially a fracture of one of the long bones of the leg, acts as an exciting cause. The devel-

opment of an acute infection may have a similar effect. Pneumonia and erysipelas act frequently in this way. It has also been stated by a recent writer that an insidious toxemia of intestinal origin appears to be the determining cause in some attacks. Many careful clinical observers assert that delirium tremens may occasionally be due to a too abrupt withdrawal of the daily allowance in the case of regular soakers. This is doubted by many, and Norman Kerr characterizes the statement as a mere superstitious tradition. It must not be forgotten, however, that in individuals with a high tolerance for it alcohol has a definite food value. To the extent of about $2\frac{1}{2}$ ounces daily (5 oz. whiskey) alcohol may be utilized as a food, especially in conditions of impaired nutrition, by the ordinary individual. By those who have acquired a tolerance, experiments indicate that it can be made use of in distinctly larger amounts, and in such individuals it is a food very readily appropriated by the heart muscle (26) (21).

It is questioned also by many good observers whether alcohol is the final factor in delirium tremens. Prof. Jaurez, of Vienna, has put forth the view that the immediately responsible toxic substance is an anti-alcohol generated by the alcohol in the system.

Francis Hare, in his report of the Norwood Sanatorium for the year 1908 (23), quotes this hypothesis, and states that he regards it as more consistent with the clinical history and phenomena of chronic alcoholism, delirium tremens, and alcoholic epilepsy than any other view hitherto introduced.

TREATMENT

At the outset of the premonitory symptoms active elimination of the poison should be commenced promptly if the patient's general condition permits. A mercurial purge should be given at once, consisting of five grains (gm. .3) of calomel with ten or fifteen grains (gm. .6-.9) of sodium bicarbonate, and should be followed in a few hours by an efficient saline. Hot water should be given freely to drink, or if it is preferred by the patient a weak cream of tartar lemonade. Rest and sleep should be encouraged by warm baths or hot packs. The introduction of good, nutritious, and easily appropriated food is by all clinicians considered of the greatest importance, but the stomach not infrequently is in no condition for effective digestion. Food imperfectly digested and unabsorbed can do no good and only becomes another source of irritation. In such cases it may be advisable to give the stomach complete rest for twelve or twenty-four hours, using for the time predigested nutrient enemata or, if the patient's condition will permit, simply injections of normal saline solution. During this period cracked ice, aerated waters, or frequent draughts of simple hot water may be given freely to drink, and a mixture of bismuth subcarbonate (gr. x; gm. .6), sodium bicarbonate (gr. xv;

gm. 1), with *nux vomica* (m. x; c. c. .6) may be given every three hours. During this period a limited amount of alcohol may be allowed, but with few exceptions this amount should never exceed half an ounce well diluted, preferably with Vichy or other alkaline effervescent water, every two or three hours.

If sleep cannot be obtained by means of baths or packs, one or two doses of a hypnotic, preferably paraldehyde (1 dr.; gm. 4.) in an ounce of spirits may be given during the night.

As soon as possible feeding by the stomach must be resumed and a liquid, easily assimilable, and nutritious dietary should be ordered at regular intervals. Whey, milk with the addition of one drachm of sodium bicarbonate to the pint, milk and lime water, milk and Vichy water or aerated soda water, malted milk, and tea or coffee with a large supply of milk in them are the most suitable and afford the most nutrition. Beef tea and broths of all kinds if well seasoned are often grateful but contain much less nourishment. In a few cases beaten eggs or finely minced meats may not tax too heavily the digestive powers.

When the patient is not seen until after the delirium has developed, the same measures in regard to eliminative treatment and feeding are demanded, but vasomotor and cardiac stimulation in addition will be required from the outset. Elimination must be maintained during the course of the attack, but too violent catharsis is to be avoided. Water, and especially hot water, should be drunk freely, but occasionally cream of tartar lemonade or an alkaline aerated water may be more acceptable and may to a certain extent replace the hot drinks. If, owing to the gastric irritation or to the delirium, difficulties should arise in inducing the patient to drink water, normal saline solution should be given freely per rectum or, if necessary, intravenously. Feeding is most important. As a rule delirious patients take nourishment well, but in some cases it is absolutely refused. With tact, forbearance, and perseverance it is generally possible to get a sufficient amount down to avoid the necessity of passing a tube through the nose and feeding through it, a maneuver which requires several assistants and gives rise to much struggling and consequent exhaustion. No food is more suitable in these cases or more nutritious than some form of milk food with a low fat percentage and rendered sufficiently alkaline to pass through the stomach and be digested in the small intestine. Buttermilk, if the patient will take it, is one of the best forms in which milk can be taken. Highly seasoned broths are often grateful as a change but have a low nutritive value. Solid food is generally imperfectly digested and any indigestion only adds to the symptoms of motor unrest and cardiac depression. Beaten eggs and egg-nog are sometimes permissible; predigested foods may in some cases be required.

The patient should be placed in bed in a quiet, well-ventilated, and

somewhat darkened room so that he may be as free as possible from external sources of irritation. His bed must have no hard sides against which, in his sudden movements, he might be seriously hurt and thus his condition be aggravated; if such hard sides exist they must be carefully padded. An easy mattress placed on the floor may be recommended in some cases. Two strong, alert nurses should be constantly in attendance, and when this is impracticable effective restraint must be employed. The old-fashioned straight jacket of duck or canvas is altogether too irritating and oppressive and should never be employed, but by means of soft bandages or towels, placed over a layer of cotton wool to prevent abrasion, the wrists and ankles may be secured to the sides of the bed, and a broad, strong sheet may then be thrown over the patient's body and secured under the mattress. This is generally sufficient and does away with the necessity of a second nurse. If, however, the patient is very restless and delirious, the shoulders may be still further secured by a second sheet, which is taken from the top of the bed up over one shoulder, then down through the axilla and across the back to the opposite axilla, then out and across the front of the shoulder, back to the top of the bed again, where both ends are secured. In whatever way these restraining sheets are applied, care must be taken to avoid undue pressure on, or actual constriction of, the chest wall lest it interfere with respiration. Isolation with the liberty of moving about in a room prepared so that the patient can do no harm to himself may be permitted in primary cases occurring in robust individuals, but as a rule rest in bed is demanded and is preferable.

Throughout the course of the attack a careful watch must be kept on the heart muscle and such stimulation employed as may be deemed advisable. Strychnin in these cases appears always to be of benefit and may be given by hypodermic injection in doses from 1/40th to 1/25th of a grain (gm. .0015-.0025), and repeated at intervals of four or six hours. In the more severe cases the action of digitalis will also be demanded. Some years ago this drug was given in heroic doses with unfortunate results, but in more moderate doses it is of unquestionable value. Wood recommends that the tincture be given in doses of m. x—m. xv (c. c. .6-1.00) every four hours or, if necessity arise, every two hours.

With the amount of gastric irritation always present in these cases, drugs, as far as possible, should be given hypodermically. For this reason a reliable preparation of digitalin is to be preferred to either the tincture or the infusion by the mouth. Should there be a profuse clammy perspiration atropin may be added to the strychnin and digitalin, as in the following combination:

Strychnin sulphate, gr. 1/40 to 1/20th,
Atropin sulphate, gr. 1/200th,
Digitalin, gr. 1/50th,

in one hypodermic injection, to be repeated every four or six hours. The effects of the atropin, however, must be carefully watched and, if any indication of its toxic action becomes manifest, it may be omitted altogether in several of the injections given during the course of the day. Of our other cardiac stimulants caffein is the most reliable, but if given too freely may increase the insomnia and motor unrest. It is best given hypodermically in the form of the sodiosalicylate, gr. ii-iv (gm. .13-.25), and may be repeated every three or four hours. Camphor also appears to have a definite value and in a ten per cent. solution in olive oil may be given hypodermically, 10 to 20 minims every two, four, or six hours as a prompt stimulant. Its action, however, is not as well defined as the preceding.

As a vasomotor stimulant Lambert strongly recommends the use of ergot in full doses. He recommends its use in the form of Livingston's solution, which is as follows: "One drachm of the solid extract of ergot is dissolved in an ounce of sterile water, to which are added three drops of chloroform and three grains of chloretone, and the solution is then filtered. Thirty minims of this solution should be given intramuscularly, never subcutaneously, every two to four hours. The best regions for its administration are those of the gluteus or deltoid." Lambert claims for this treatment that it reduces the caliber of the dilated blood vessels, lessens the various congestions, and brings about a better equilibrium of the circulation. As the result of it he claims that there is a distinct tendency to a quieter delirium, with less need of restraint; there is less tremor; less of the hypnotic is required, and the tendency to wet brain is diminished. Symptoms of ergotism never appeared, although "in some cases thirty minims of this solution were given every two hours for ten days or longer." Careful aseptic precautions must be taken in giving the injections, otherwise painful spots or abscesses may result.

The necessity of securing sleep as soon as possible in delirium tremens always appears to be a very imperative one, and, as recovery almost invariably follows the prolonged critical sleep which comes naturally, the belief arose that to cure delirium tremens it was only necessary to force sleep. Sir Thomas Watson, in his lectures on Physic, expressed this view strongly, advocating the employment when necessary of large doses of opium, which at that time was given only by the mouth. Several cases of unfortunate over-dosage were reported. Since then all the newer hypnotics have had their trial. But the testimony of clinicians is that excepting in mild attacks all of them fail during the first few days unless they are given in very large doses. The sleep secured by them is brief and seldom influences the delirium, but the motor excitement may be slightly lessened under their use. Against this must be placed their toxic and depressing action upon the nerve centers. Of

the hypnotics which have been recommended in this affection, chloral hydrate is one of the most powerful, but has a toxic action on the heart and is distinctly dangerous when any condition of degeneration exists in the cardiac muscle. Lancereaux claims that with efficient stimulation of the heart it is safe in doses of from thirty to sixty grains. It is very questionable whether such doses are advisable excepting only in the case of robust young men. Lambert recommends its occasional use in combination with morphin, and states that a second dose may be repeated in an hour's time. Caution, however, must be employed, as deaths have been reported from its use in these cases. Paraldehyde is much safer, and, if given in one-drachm (4-c. c.) doses in a little spirits, often acts promptly. A second dose may be repeated in one or two hours. Sulphonal, trional, and veronal are less effectual. Wood recommends a combination of trional (gr. xx; gm. 1.3) with sulphonal (gr. x; gm. .6). Hyoscin or scopolamin has been employed by some clinicians. Lambert states that a combination of hyoscin hydrobromid (gr. 1/100; gm. .0006) with apomorphin hydrochlorid (gr. 1/20—gr. 1/10; gm. .003-.006), and strychnin sulphate (gr. 1/30; gm. .002) given hypodermically may quiet delirium and secure at least a few hours' rest.

[The principal, if not the only, indication for hyoscin hydrobromid is motor sleeplessness. When used for this its effects are nothing short of magical.—Editor.]

The bromids in large doses (gr. xl-lx; gm. 2.6-4) repeated every three or four hours have been recommended by some writers to lessen the motor excitement. With the impaired nutrition of the nerve cells already existing due to the alcoholism, bromids will accomplish little good, and in such large doses may do definite damage. McCarthy states that he has seen grave complications with symptoms of profound nerve changes ensue from the excessive use of bromids in this disease. Wood considers they may be of service in ten-grain doses repeated every two or three hours. The employment of hypnotics in this affection is, therefore, far from satisfactory, yet in an uncertain way many of our best clinicians do recommend their cautious use.

It must, therefore, be a matter of careful consideration in each case how far it is wise to attempt to force sleep by our narcotics during the early stages of this affection. As a self-limiting disease, terminating in the great majority of cases before the fifth day, our chief reliance should always be placed on elimination and support. Hydrotherapy in many cases will afford us much assistance. A cold wet-sheet pack, repeated two or three times, will prove both sedative and tonic, frequently inducing quiet sleep without the untoward effects of hypnotic drugs. Still more powerful is the cold affusion strongly recommended by the late Sir William Broadbent. The patient should lie, stripped of clothing, on a blanket over a mackintosh sheet. Cold iced water, by means of a

large sponge, is dashed over the body back and front for several minutes; strong rubbing, especially of the extremities, is kept up as the water is dashed on the body. The patient is then dried with a rough towel, the friction being maintained for some minutes. This process is repeated two or three times, after which the patient is placed in a warm bed with hot water bottles to his feet. By the time the arrangements have been completed to make him comfortable he is on the verge of a sleep which will prove more beneficial than that to be obtained from any hypnotic. This cold affusion may be repeated with benefit once or twice daily. Neither albuminuria nor pneumonia are contraindications.

Toward the end of the third or fourth day if sleep has not been obtained and the patient shows signs of exhaustion, an attempt may be made to assist the oncoming of the critical sleep. At this period of the disease the addition of morphin sulphate (gr. $1/6$ - $1/4$; gm. .010-.015) to the injection of strychnin and digitalin above mentioned may prove of much value. Should there be any contraindication to the use of morphin, the combination of trional with sulphonal or of paraldehyd followed by either trional or sulphonal may be tried.

The amount of alcohol to be supplied to a patient after the onset of delirium tremens must be carefully decided in each case. Delirium must to a certain extent be regarded as an abstinence symptom, and occasionally the onset of an attack may be arrested in alcoholics by a judiciously cautious tapering off of the amount of spirits allowed them. Once the delirium has begun many physicians consider it wise to withhold all alcohol. Francis Hare states that as a result of his experience in the Norwood Sanatorium he is strongly inclined to the plan of withholding all alcohol and all drugs. The majority of his cases are so treated, and as a result he believes that the attack is shorter in duration though possibly more violent. Alcohol, he believes, modifies the symptoms of an attack but seems to defer the crisis.

In the majority of cases as soon as food is taken readily and the patient is under the influence of strychnin and cold packs or affusions very little alcohol is called for; but if food is taken or appropriated with difficulty, if the pulse begins to fail and becomes frequent and weak and the skin cool and clammy, alcohol is required chiefly as an easily appropriated and readily oxidized food.

While the death rate of uncomplicated cases of delirium tremens is very low (from 1 to 3 per cent.), yet in no disease must the physician be more constantly on his guard to detect the presence or onset of complications. The condition of the heart and of the respiratory system demands constant watching. Pneumonia is one of the most frequent complications. It is generally ushered in by a rise in temperature, but its onset is often insidious. About 50 per cent. of those thus attacked die. In a few cases the pulse gradually weakens, the delirium continues

but becomes of the low muttering kind, and gradually general failure of the circulation sets in. In others death may occur from sudden syncope occurring on some attempted exertion. Hyperpyrexia is rare, but may develop with symptoms of a failing circulation, cold hands and feet, and a rectal temperature of 105-107°. It is a condition almost invariably fatal, but cold affusions over the head and body may be tried.

In some instances, after a few days the patient sinks slowly into a semi-comatose condition with low muttering delirium and constant movement of the arms and hands. It becomes increasingly difficult to rouse him to answer questions or take any food. The pulse becomes very rapid and weak, the temperature only slightly raised, the skin becomes hyperesthetic, and meningeal symptoms develop, manifesting themselves in contracted pupils, stiffness and contraction of the muscles at the back of the neck, rigidity of the arms and legs and of the abdominal muscles. Kernig's sign may be present. These symptoms were first described by Dana under the title of "wet brain," and may occur in all forms of alcoholism, and appear to be due partly to the direct toxic action of the alcohol, but chiefly to a weak heart action with vasomotor paresis. The condition calls for vasomotor stimulation. Recovery may take place after an illness of some weeks' duration, but convalescence is very slow.

OTHER FORMS OF DELIRIUM

Acute Hallucinosiis of Drunkards.—In some alcoholics symptoms arise of a subacute delirium in which hallucinations of the sense of hearing become very prominent. The patients are as a rule young and well educated, and an attack may follow mental shock or some acute gastric disturbance. In the beginning there is much irritability of temper, with restlessness and sleeplessness, associated with hallucinations which become more frequent and more imperative. When the affection is at its height the patient is persistently disturbed by voices which demand his attention. They generally arise from some special quarter, sometimes behind him, sometimes from the floor, or from behind a wall, and follow his every movement. In the street the voices shout aloud his thoughts, so that he often flies in terror from his imaginary persecutors. His consciousness of time and environment is not clouded, and his power of connected thought and his coördination of facts are fairly normal. The hallucinations are almost wholly confined to the sense of hearing. Under treatment they gradually decline, occur at longer intervals, and become less imperative. An attack as a rule lasts from four to eight weeks. Without efficient care there is always danger that the patient may commit suicide. For this reason he should be placed under the charge of an alert nurse. All sources of irritation should be removed. Special atten-

tion should be given to the stomach and bowels. The diet should be nutritious. Hypnotics are generally demanded at first. Later on, massage and hydrotherapy should take their place.

Korsakow's Psychosis.—Reference must also be made to a peculiar condition of delirium associated with a polyneuritis of variable extent, and classed as a distinct psychosis by Korsakow. It resembles a similar affection produced by poisoning from lead, arsenic, cocain; sometimes it is a sequence of grippe. In this affection we may meet with a complete loss of orientation, an inability to recognize even near friends and relatives, a loss of memory for the recent past, and sometimes for some events in the more distant past. The sense of time is either lost or much impaired, so that the patient is unable to state whether an event occurred only a few minutes previously or many days or weeks in the past. At the same time there is a fabrication of stories and of pseudo-reminiscences of the most absurd character.

It begins as a delirium not unlike delirium tremens, but the delirium persists and does not terminate with any critical sleep. Disorders of sensation arise, soon followed by paralysis, as a rule most pronounced in the extensors of the lower limb. Atrophy sets in quickly. Hallucinations of sight and touch occur only at night in mild cases, but in the more severe they disturb both night and day. The emotional condition varies much. In a few instances paralysis of local groups of muscles, notably those of the eye, throat, and larynx, may occur.

The course of the affection is generally slow and protracted. The mental symptoms develop slowly and the neuritis may show signs of improvement while the mental symptoms are still developing. Not infrequently some intercurrent disease brings on a fatal ending. In the early stages the more severe the delirium the more unfavorable the prognosis. When the cranial nerves become involved it adds to the gravity of the prognosis.

The treatment to a great extent is symptomatic, and for the first few weeks at least the patient should be in some institution where he can receive every care. Rest in bed is demanded, and a generous dietary with the addition, in the later stages, of massage, electricity, and perhaps strychnin. As improvement sets in, a careful education may be attempted of those centers which are least affected. Many cases which appear helpless may be much improved under the care of an experienced specialist.

ACUTE WOOD ALCOHOL POISONING

Columbian spirits, wood naphtha, methyl, or wood alcohol, now used extensively in the arts and in many households, is a most dangerous poison when taken internally owing to the fact that it is excreted from the body very slowly, and under certain conditions appears to be converted into

the highly toxic formic acid with occasionally fatal consequences. As it is very cheap it has been used by unscrupulous manufacturers of flavoring and medicinal extracts as an adulterant for ethyl alcohol. It has also been drunk as a substitute for whiskey by persons during a debauch.

The intoxication caused by methyl alcohol is at first not unlike that produced by whiskey, but is more prolonged and may be accompanied by convulsive movements. The after-effects vary, according to the amount of the alcohol converted into formic acid in the system. The majority of those who have drunk it appear to have escaped without permanent danger; in quite a few cases permanent blindness has set in, and in yet others the intoxication has terminated fatally. The damage to the ocular apparatus consists chiefly of a destructive inflammation of the optic nerve fibers or retinal elements, followed by atrophy. The blindness is bilateral and may set in a few hours after the inhibition of the poison, or may be delayed for several days. In some cases a slight temporary improvement may occur after a few days, but in 90 per cent. of the cases in which the eye becomes affected permanent and total blindness results.

The prognosis in every case is very uncertain, and does not appear to be entirely dependent on the amount taken.

Treatment is most unsatisfactory. In all cases, if seen early, the stomach should be promptly evacuated by the readiest means available, and free catharsis should be secured by a drachm of compound jalap powder or an ounce of magnesium sulphate. Afterward diaphoresis should be promoted by a hot bath or by pilocarpin. Water, either hot or cold, containing sodium or potassium bicarbonate in solution, should be drunk freely and the patient should be kept on a milk diet. Should signs of collapse or weakened heart action arise they should be combated by strychnin (gr. 1/20; gm. .03) or caffeine (gr. iii; gm. .2) given hypodermically. Should symptoms of optic neuritis develop, the strychnin should be continued and potassium iodid in ten-grain doses given three times a day. It must be remembered, however, that in these cases treatment has done very little good.

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CHAPTER II

OPIMUM POISONING—OPIMUM AND MORPHIN ADDICTION

A. D. BLACKADER

Next to alcohol, opium is the most pernicious and extensively used intoxicant. The amount consumed by Eastern nations has reached appalling figures, while even in Europe and America the use of the drug as an intoxicant has increased greatly during the past fifty years. Sir William Roberts, who studied the question of opium-eating carefully when in India some years ago, came to the conclusion that its mischievous effects were in many cases not so grave as commonly believed, and that its practice under some conditions of native life appeared to be beneficial rather than harmful. Severe tasks are accomplished and prolonged religious fasts endured, which, it is claimed, would be impossible without its assistance. With us in the west a continuous moderate employment of the drug must be regarded as the rare exception. Clifford Allbutt (1), however, mentions a few instances in England that have come under his notice. Such an employment of this narcotic must always be regarded as extremely dangerous; as a playing with fire almost certain to end disastrously.

Poisoning by opium, or its alkaloid, morphin, confronts the physician either in an acute form, when a poisonous dose has been taken by accident or with criminal intent, or in a chronic form, when the patient has permitted himself to be enthralled by a frequent recourse to its pain-numbing but brain and body-enslaving action.

TREATMENT OF ACUTE POISONING

As promptly as possible the stomach must be evacuated, but, as the medullary centers are benumbed by the poison, emetics often fail. If the stomach tube is not immediately available, zinc sulphate (gr. xxx, gm. 2) or a tablespoonful of strong mustard flour in a cupful of water may be tried; but as soon as a tube can be obtained the stomach should be washed out with a solution of potassium permanganate (1 in 500 to 1 in 1,000),

and about half a pint of this solution allowed to remain after the tube is withdrawn. As the morphin continues to be excreted through the glands in the stomach and duodenum, and if allowed to remain may be reabsorbed, Moore recommends that the tube be reintroduced every half hour or hour and the process of washing repeated. Tannin may also be used to neutralize any alkaloid in the stomach, but is not so effectual as the permanganate.

As the stupor deepens, means must be taken to stimulate the respiratory center. Atropin has long had a reputation as a respiratory stimulant, but must be employed cautiously, as an overdose will certainly depress and increase the toxic symptoms. Not more than 1-50 gr. (gm. .0003) should be given in any one case. Strychnin and caffein are more trustworthy (strychnin, gr. 1-30—1-20, gm. .002-.003, caffein sodiosalicylate, gr. v, gm. .33), may be given at once by hypodermic injection, and the dose may be repeated in an hour's time.

As a result of his experiments in animals, Reichert has recommended cocain hydrochlorid (gr. $\frac{1}{2}$, gm. .03) as a respiratory stimulant to antagonize the effect of the morphin, but the action of cocain in man is often uncertain; so we have more confidence in the combination of strychnin with caffein. Camphor may, however, prove of service as an additional stimulant, and one or two grains (gm. .06-.13) in oil may be given by hypodermic injection and may be repeated every two hours, if necessary. Strong coffee, or strong green tea, may be introduced into the rectum to the extent of half a pint at a time.

Wood (15) insisted on the value of all measures to keep the patient awake so as to bring his will-power to bear on the respiratory act, but too violent measures will induce exhaustion, which ought to be avoided. The electric brush, however, forms a powerful means of excitation, and can do no harm. Douches of hot and ice-cold water over the nape of the neck while the patient is in the recumbent position are preferable to an indiscriminate application of cold water, as is sometimes recommended, and will not unduly lower the patient's temperature. Should the stupor increase, and the respiratory center show indications of failure, artificial respiration must be maintained either by Sylvester's method, with relays of assistants, or by the employment of some artificial respiration apparatus. Fell states that, by means of his apparatus, he maintained artificial respiration for 72 hours, and succeeded in saving a patient who had taken 33 grains of morphin. Improvement in the color of the skin and in the tone of the pulse are the first indications of commencing recovery, but artificial respiration must be maintained until the natural respirations are as frequent as 8 or 10 to the minute. In all cases care must be exercised to maintain the heat of the extremities, and of the body generally, by hot blankets and hot-water bottles. The administration of alcohol is not advisable.

CHRONIC POISONING AND ITS TREATMENT

Chronic Opium or Morphin Intoxication.—This develops as the result of three practices: that of the opium eater, by whom the crude drug or one of its preparations is taken by the mouth; that of the opium smoker, who inhales the fumes of the prepared drug burned in a special pipe; and that of the morphinist, who injects morphin under his skin by means of the hypodermic needle.

OPIUM EATERS.—In the majority of those of European descent who habitually take opium or one of its preparations by the mouth the effect first demanded has been the relief of pain. Persistent or frequently recurring pain is apt to cry imperatively for relief, and in many individuals its relief by morphin induces in addition such a sense of exhilaration and general comfort that the recourse to it insidiously becomes a habit. Especially is this apt to be the case in neurotic individuals, in degenerates, and in those who have been trained in habits of self-indulgence. Those who have fallen into the habit of using opium for the mere pleasure of its effects are few in number and generally prefer smoking or the morphin needle. In the East it would appear that these proportions are reversed. Tee Han Kee, writing in the *Philippine Journal of Science*, states that the majority of the confirmed consumers of the drug in China began its use simply for the pleasurable effects arising from it, and because it is not so violent in its action as alcohol; only a minority attribute their addiction to a habit arising from the widespread popular employment of opium in domestic medicine.

OPIUM SMOKING.—This is said to be a very ancient method of obtaining the narcotic action of the drug, and when used in this way the injurious action of opium is said to be slower in developing and more under control than when taken by the mouth. In the East it is the most frequently employed method of using the drug, especially by the Chinese. By them it was introduced into San Francisco, and from this place as a center the habit is said to have extended greatly of late years, and its *habitués* may now be found not only among the dissolute and abandoned, but also among the wealthy and even among the working classes in many of the large cities of America. Not all smoke to excess, and the indulgence, when first started, only takes place at intervals, often of considerable length. The effect desired appears to be not that of heavy slumber, but rather a condition of dreamy wakefulness, during which the smoker enjoys conscious freedom from care and a sense of superiority over the troubles and worries of life. With many there is a distinct increase in sexual desire.

Gradually, with the smoker, as in the other forms of opium addiction, the exhilarating and soothing effects of the drug become more and more difficult of attainment, and the depressing effects more prominent.

MORPHIN ADDICTION.—This is a comparatively recent vice, and its disastrous effects are more rapid and more marked than those of either of the preceding methods of using the drug. The morphinist is more difficult to control, and much more difficult to treat, and the symptoms of mental and physical enfeeblement appear earlier, and, as a rule, run a more rapid course. The introduction of the hypodermic needle by Dr. Alexander Wood, of Edinburgh, 50 years ago has not been an unmixed good, and unfortunately statistics show that physicians and their wives, pharmacists, and nurses form a large percentage of the total number who have become addicted to its use.

Treatment.—It must be stated quite frankly at the outset that the only place where an opium or morphin *habitué* can be properly treated is a sanatorium or hospital. To break the addiction not only requires constant medical surveillance on account of the severity of the symptoms that may arise, but also demands that the supply of the drug be under the absolute control of the attending physician; a condition impossible to secure in the patient's home, in the midst of his ordinary attendants, whose sympathy he can elicit, or whose aid he can secure by threats and bribes.

Before the patient enters his room or ward he should be given a bath, and all his own clothes should be removed and hospital linen supplied to him. Before his own are returned, a very thorough examination of them should be made, without the knowledge of the patient, by an alert nurse accustomed to deal with this class of patient. Too often, quantities of the drug will be found stowed away in some secret place, sewed into the lining of a coat, or secreted in a slipper. The choice of the attendants is of great importance, as upon their trustworthiness and efficiency the result of treatment will in great measure depend. Much also will rest upon the tact and judgment of the physician himself, who must, as far as practicable, carefully conserve and strengthen the sense of self-respect in all his patients, especially in those who manifest some self-control and an earnest determination to conquer their enslaving appetite.

The treatment in all forms of opium addiction consists in a more or less rapid withdrawal of the daily allowance of the drug; the rapidity being dependent on the condition of the patient and the amount previously taken daily. The patient must be supported through this withdrawal period by rest, by a carefully arranged but nutritious dietary, by massage, and by such hydrotherapeutic and other remedial measures as may be deemed most suitable and needful at the time. The hypersensitive nerves and enfeebled circulation demand careful, sometimes heroic, stimulation, and the patient himself will require all the moral support and sympathy that his attendants can give him. This treatment, to be successful, calls, as a rule, for weeks, sometimes months, of residence in the sanatorium, and, when he leaves that institution, for the careful oversight of an experienced and sympathetic physician.

The withdrawal in confirmed *habitués*, if abrupt, always gives rise to intense suffering. With the lack of the accustomed dose, restlessness and a depressing sense of malaise quickly develop; the face becomes pale, and the features anxious; yawning and sneezing become irresistible, and a profuse coryza frequently sets in. In severe cases, about the second or third day, vomiting, diarrhea, and profuse sweating, with symptoms indicative of grave cardiac weakness, develop. Sudden collapse may occur several times a day, in which, for periods lasting from 15 to 30 minutes, the patient will have an almost imperceptible pulse, with ghastly, pale, pinched features and a sense of dyspnea. A disturbing choreic jactitation of the limbs still further exhausts the patient. Mental confusion, with hallucinations and delusions, and, in extreme cases, even a maniacal condition, may develop and take a suicidal tendency.

On account of the frequent development of such alarming symptoms, an abrupt withdrawal is never to be recommended, except, perhaps, in the case of young and comparatively healthy patients whose daily dose does not exceed four or five grains of morphin. On the other hand, if the withdrawal is stretched over too long a period, valuable time is lost and the patient and his friends may be discouraged. The best results, as a rule, are obtained by a withdrawal as rapid as may be consistent with the patient's strength, and as may be advisable in the conditions which may develop. It is seldom necessary to prolong the withdrawal over two weeks.

The plan usually adopted is on the first day of the withdrawal to reduce the narcotic to one-half the amount of the previous usual daily allowance. On the second day this is again halved, and again on the next day, and so on till the drug is entirely withdrawn. In some cases even this rapidity cannot be maintained, and intervals when the reduction is stopped must be permitted, so that, in these cases, the withdrawal advances in a series of descending steps. In the very weak, and in those suffering from chronic debilitating disease, even this method may prove too rapid, and the withdrawal must be allowed to go on very slowly; but even with the most gradual withdrawal some distressing symptoms will make their appearance. In all cases the last one or two days of withdrawal is the time in which the patient feels the abstinence most keenly, and to lessen this distress some physicians, on stopping the hypodermic, give an opiate by rectal injection, gradually substituting for the drug a weak alkaline or normal salt solution. Others administer codein by the mouth or subcutaneously. Dionin and heroin have also been employed, but are more dangerous. *During the withdrawal, if none of the distressing symptoms occur, the patient is certainly obtaining the drug surreptitiously.*

Shortly after the narcotic is entirely withdrawn, the symptoms of distress begin to pass off, the face loses its anxious expression, sleep is more

easily obtained, and is more restful, nutrition improves, and vigor gradually returns. Care is still necessary, for alarming symptoms are reported to have occurred even after convalescence has set in.

The amount of rest demanded during the withdrawal will vary with the condition of the individual patient and with his reaction to the treatment. In all severe cases, and especially in those suffering from impaired nutrition, rest in bed, with isolation from all sources of disturbance, is imperative during all the later days of the withdrawal and for the next few succeeding days. In milder cases some liberty out of doors may be permitted, and in these light amusements may be of assistance. Erlenmeyer (5) insists on the importance of seclusion, rest in bed, and warmth in promoting restoration during the abstinence struggle. He orders every patient to bed at the outset, and asserts with confidence that those who submit to this till a change is allowed get on more easily and satisfactorily during the treatment than those who insist on moving about or having the run of the premises. In those enfeebled by chronic disease or suffering from the cachexia of prolonged narcotism, rest in bed should precede by some days any attempt at withdrawal.

Of equal importance with rest in bed is the patient's food, which should be carefully arranged to suit his digestive powers and should be as nutritious as possible. In the majority of cases both appetite and digestion are impaired, and the feeding becomes one of the most important and yet most difficult parts of the treatment. Milk, alkalized with sodium bicarbonate or with lime water, and, in some cases, perhaps peptonized, is, when it can be taken, both nutritious and digestible; it may be supplemented by highly-seasoned broths, beef juice, beaten eggs, and coffee and tea with cream. Systematic feeding of moderate amounts at regular intervals gives the best results. If nausea and vomiting set in, bismuth carbonate or subnitrate in full doses may be administered, and iced broths or meat essences, and coffee without cream may be given in small quantities. Diarrhea is promptly controlled by opiate injections. In conditions of cachexia and enfeebled circulation, if sufficient nourishment is not taken, alcohol in some form may be demanded, but its administration must be under careful control and must not be continued for a longer time than is deemed absolutely necessary.

To relieve the nervous restlessness, gentle massage will often prove of service. Hot baths at a temperature of 110° F., in which the patient should lie immersed for ten minutes, will generally prove grateful and will have a stimulating effect. They may be repeated if necessary twice a day. Many writers recommend for this nervous restlessness during the withdrawal large doses of sodium or ammonium bromid. Mattison (11), who was apparently the first to use massive doses of these drugs, administered on the first day of withdrawal 100 grains of the sodium salt in divided doses, and gradually increased the amount till it reached 200

grains, continued it at this amount for three or four days, and then abruptly stopped it. McBride (10) recommends a mercurial cathartic, followed by an effective saline, to be taken previous to the withdrawal. Sodium bromid is then ordered in 30-grain doses, dissolved in 6 or 8 ounces of cold water, repeated two or three times a day, and given preferably on an empty stomach. This amount is increased by thirty grains daily until 200 grains are taken in the twenty-four hours; the increase in the bromids corresponding with the rate of withdrawal; so that the maximum sedation is reached at the same time as the maximum irritation. The bromidal medication is continued for not longer than one week. Sometimes five or six days suffice. Given in this way, no effect is usually produced by the bromid before the third day. From the third to the fifth day an unpleasant taste is complained of, and the bromic breath begins to be noticeable; the patient is drowsy, and there is a growing indisposition to muscular exertion. From the fifth to the seventh day these symptoms increase. General relaxation is marked, the pulse is less frequent, usually about 60; the voice weakens; the pupils dilate; mild hallucinations of sight and sound, almost always of sight, occur occasionally for three or four days, accompanied by a tendency in speaking to substitute one word for another. After the ninth or tenth day the bromidal manifestations gradually disappear, so that, within two weeks from the beginning of the treatment, the patient is generally up and the only prominent symptoms remaining are debility and insomnia.

Francis Hare (6), in his annual report of the Norwood Sanatorium, speaks of medication during withdrawal as follows: "The administration of massive doses of sodium bromid toward the end of the reduction period has been of considerable assistance in shortening and rendering more easy the process of withdrawal. It is the only drug which I have found of material use in modifying the mental distress."

After the bromids and opiates have been stopped, a few doses of codein, given either by mouth or subcutaneously, will carry the patient through to convalescence. At the same time a course of strychnin in full doses, with or without the addition of atropin, should be commenced; to which later on iron, quinin, or arsenic may be added as the condition of the patient may be deemed to require.

Such heroic bromidization of poorly nourished nerve centers is, however, in the opinion of many physicians, very questionable therapy, and (see *Delirium Tremens*) its effects on the nerve centers may be traced for months afterward.

Preferable, in our opinion, to sedation by the bromids is the action of the solanaceous alkaloids. Lott, of Texas, first used hyoscin in the treatment of morphinism, giving one-hundredth of a grain of the hydrobromid hypodermically every two hours for the two or more days during which the morphin was withdrawn. This heroic dosage fails to secure

sleep, but induces a condition in which the patient lies awake but stupefied, mumbling continuously. Since then it has been employed by many with variable success. In 1909 Lambert (9), of the Bellevue Hospital, New York, described a method of treatment first originated by Mr. Town, and now known as Town's specific treatment, for the obliteration of the craving for narcotics. In a second paper, published recently, he claims that the statements made in his former article concerning the efficacy of this treatment have been confirmed, and that it must now be regarded as the most successful method for the treatment of all the drug addictions. The method is as follows: The specific mixture consists of two parts of the old 15 per cent. tincture of belladonna and one part each of the fluid extract of xanthoxylon and of the fluid extract of hyoscyamus. With a weaker tincture of belladonna the results obtained are not so satisfactory. The bottle containing this mixture must be kept well corked and shaken before using. While the specific is being given the patients do not suffer from the intense diarrhea which usually accompanies the withdrawal of the drug. On the contrary, the most energetic drastic cathartic medication is necessary to obtain the desired elimination and to make their bowels move satisfactorily. This cathartic medication forms one of the crucial points in the treatment. Unless it is properly carried out, the treatment will fail and the patients suffer intensely and to no avail.

The most useful combinations in his hands to effect this catharsis have been the compound cathartic pills of the pharmacopeia. The ordinary stock preparations are too dry to be effective, therefore Lambert directs the pills to be made freshly and to have the mass put into a capsule. Occasionally a stronger combination is required, and then he uses the vegetable cathartic pills of the pharmacopeia, with additions according to the following formula:

		Gm. or c. c.
Extracti colocynthis compositi.....	gr. i	.06
Extracti hyoscyami	gr. ss	.03
Extracti jalapæ	gr. ss	.03
Extracti leptandræ	gr. ¼	.015
Resinæ podophylli	gr. ¼	.015
Olei menthæ piperitæ.....	m. ⅛	.008
Olei resinæ capsici.....	m. 1-10	.006
Olei resinæ zingiberis.....	m. ss	.030
Olei crotonis	m. 1-25	.0025
Fiat pilula.		
Misce.		

The exact details of the treatment as given by Dr. Lambert are as follows:

"A patient addicted to morphin is given five compound cathartic pills and five grains of blue mass, and six hours later, if these have not acted, they are followed by a saline; after three or four abundant movements of the bowels from these cathartics the patient is given, in three divided doses at half-hour intervals, two-thirds of the total daily twenty-four-hour dose of morphin or opium to which he has been accustomed. Observe carefully after the second dose has been given, as the amount then equals four-ninths, or nearly one-half, the total twenty-four-hour dose. Some few patients cannot comfortably take more than this amount. At the same time with the morphin, six drops of the belladonna mixture is given in capsules. This belladonna mixture in doses of six drops (and by drops I do not mean minims, I mean drops dropped from an ordinary medicine dropper, which is about half a minim dose) is given every hour for six hours. At the end of six hours the dosage is increased by two drops. The belladonna mixture is continued every hour of the day and every hour of the night continuously throughout the treatment, increasing the dose by two drops every six hours until sixteen drops are regularly taken at each dose; it is diminished or discontinued at any time if the patient shows belladonna symptoms such as dilated pupils, dry throat, or redness of the skin, or the peculiar and incisive voice, and insistence on one or two ideas. It is begun again at reduced dosage after the above symptoms have subsided.

"At the tenth hour after the initial dose of morphin is given, the patient is again given five compound cathartic pills, and five grains of blue mass. These should act in six or eight hours after they have been taken. If they do not act at this time some vigorous saline is given, and when they have acted thoroughly the second dose of morphin is given, which is usually about the eighteenth hour. This should be one-half the original dose; i. e., one-third of the original twenty-four-hour daily dose. The belladonna mixture is still continued, and, ten hours after the second dose of morphin has been given, that is about the twenty-eighth hour, five compound cathartic pills are again given and five grains of blue mass, these again if necessary are followed by a saline seven or eight hours later. At times when the compound cathartic pills are not acting well, or too slowly, five or six of the modified vegetable cathartic pills previously referred to are given from two to three hours after the compound cathartic pills. After these have thoroughly acted at about the thirty-sixth hour, the third dose of morphin is given, which is one-sixth of the original dose. This is usually the last dose of morphin that is necessary. Again, ten hours after this third dose of morphin, i. e., the forty-sixth hour, five compound cathartic pills and five grains of blue mass are again given, followed seven or eight hours afterward by a saline, and one expects at this time to see the bilious green stool appear. When this appears, after the bowels have moved thoroughly, ten or twelve hours after the

third dose of morphin, about the fifty-sixth hour, two ounces of castor oil are given to clear out thoroughly the intestinal tract. During this last period, when the bowels are moving from the compound cathartic pills, and before the oil is given, the patients have their most uncomfortable time. Their nervousness and discomfort can be controlled usually by codein, which can be given hypodermically in five-grain doses, and repeated if necessary, or some form of the valerianates may help them. About the thirtieth hour these patients should be stimulated with strychnin or digitalis, or both. The castor oil should produce a characteristic stool, liquid and green, composed of mucus and bile. When this stool occurs the patients generally feel suddenly relaxed and comfortable. Treatment will now cease."

In some cases about the thirty-sixth hour the stools became clay-colored. Prepared oxgall, given in small doses every hour for five or six doses, was found most effective in stimulating further biliary secretion.

During the treatment the patients should be given a regular diet of easily digested food: milk, eggs, cereals, bread and butter, with tea or coffee, if they desire it. Many have a good appetite throughout. Others in poor physical condition eat sparingly till after the treatment has ended, when their appetite becomes voracious. Lambert emphasizes the necessity of avoiding overeating. An overloaded stomach may give rise to symptoms resembling those experienced during the withdrawal of the drug. Should this occur, an emetic should be given and the distressing symptoms will soon cease.

Under this treatment Lambert claims that the desire for morphin and other narcotics may be eradicated in less than five days, with a minimum of discomfort and suffering to the patient. After the specific treatment is finished the patient should be placed on a suitable tonic. Lambert states that those which contain phosphorus and arsenic do most good. Strychnin, with or without digitalis, must be continued for some time. As a rule the patients should remain under observation for some weeks. In some patients the distressing pains for which the narcotic was originally taken again manifest themselves and demand careful treatment lest, owing to their persistence, a relapse should take place. With treatment, and assisted by the flush of returning vigor, not infrequently the evidence of former disease passes away.¹

Two other methods of treatment require a brief notice. Oscar Jennings, of Paris (8), claims that by the slow plan of withdrawal and the

¹ Pettet's treatment closely resembles that proposed by Town but is simpler. He is thoroughly convinced that the more completely the system is cleansed of toxic material the less disturbance will arise during the withdrawal of the drug. No ordinary simple catharsis, in his opinion, is sufficient, for not only should the intestines be thoroughly emptied but their secretions and nerve centers demand stimulation. He begins his treatment with a course of baths to promote the activity of the sweat glands, while at the same time the patient is made to drink a large amount of water so as to secure elimination by the kidneys. The cathartic combination which he has found to be most useful is the following:

substitution at a certain stage of rectal injections for hypodermic injections, a morphin *habitué* may be cured without any compulsion and discomfort beyond what he is willing to submit to, and can easily bear. His treatment consists essentially in the use of a progressively decreasing quantity of morphin given daily in a constant quantity of salt solution in association with the use of cardiac tonics, especially spartein, to combat depression of the heart; of sodium bicarbonate, in solution or in the form of Vichy water, for the hyperacidity; and of Turkish or hot-air baths, to promote elimination. He claims a high percentage of cures in patients in whom he can elicit a gradually increasing amount of will-power, and who have sufficient time to carry out his method.

Some years ago Hirschlaff introduced a morphium heil-serum based on the idea of an antitoxin being present in the blood as the result of a persistent use of the drug. Experiments in animals, and the clinical trial of the drug in many German hospitals, do not warrant any claim for this as a successful method.

Hypnotism and mental suggestion have been employed by Hirt in a number of out-patients after the withdrawal of morphin had been completed in an institution under the care of a reliable nurse. His statistics are not encouraging. Speaking of this method, Allbutt states that it is

℞ Calomelanos:	
P. Extracti cascarae aa gr.x.....	.65
P. Ipecacuanhae gr.i.....	.06
Strychninae nitratis, gr. $\frac{1}{4}$.....	.015
Atropinae sulphatis, gr. $\frac{1}{50}$.....	.00125

Misce et divide in capsuli quatuor.

Sig. One capsule every two hours until four are taken, preferably at the hours of 4, 6, 8 and 10 p.m.

The patient should abstain from supper on the day these capsules are taken, but may receive his narcotic in the usual dose up to 8 or 10 p.m. Six or eight hours after the last capsule the patient should have 1/20 gr. (.0032) of strychnin hypodermically, followed in half an hour by two ounces of castor oil or a large dose of magnesium citrate. Both the strychnin and the oil or saline should be repeated every two hours until the intestinal canal has been thoroughly emptied.

During this stage of purgative treatment the patient should receive no morphine or other narcotic, but as soon as his demands become very imperative the narcotic may again be given in reduced doses; as a rule not more than two thirds of the dose previously demanded. Forty-eight hours from the time of the first purgative a second course should be given with the same materials and precautions as before. After this purgative the patient should be given a bath and be put to bed.

It will be found that he can now go much longer before the desire for the drug again becomes imperative, especially if he remains in bed. To relieve the craving when it arises, instead of the opiate scopolamin in 1/200 grain doses should be given hypodermically, and repeated in 30 minutes. The patient will generally fall asleep after the second dose, but if sleep fails, and restlessness ensues a third dose may be given, but if possible not till an hour has elapsed. After this the amount of dosage and frequency of repetition may require modification in the case of any undue susceptibility or tolerance on the part of the patient. If the patient sleeps for six or eight hours he should be allowed to do so, but on waking he should receive another dose of scopolamin, either of the same size as previously or slightly modified, to maintain a mild belladonna intoxication for about 48 hours. Fettey recommends during this period small doses of sodium thiosulphate every two hours to induce bilious stools unattended by colic.

By the end of the fifth or sixth day the patient should be convalescent with no unconquerable desire, but will be weak and will require medical supervision in the sanitarium for another two months.

in mild cases only that this method has had even an appearance of success. "To send a patient out into the world again with mental suggestion only to help him is to court the failure which will invariably follow" (1). Nevertheless, in selected cases, it may be used as a mental stimulant in association with the other methods of treatment.

In all cases, after the withdrawal of the drug is completed and convalescence is under way, the patient still requires careful watching if the cure is to be a permanent one. A troublesome insomnia may persist for the first week or two after the withdrawal and will demand relief. Hydrotherapeutic measures should be first tried. A hot bath or hot pack will in some cases prove effectual. In others cold packs or cold douches are more serviceable. If these means fail a powder containing twenty or thirty grains of trional with ten or fifteen of sulphonal may be given. Dercum recommends a mixture of sulphonal and veronal, and Lambert has used successfully twenty grains of chloral combined with hyoscyamus and Indian hemp. Caution must be exercised in the use of all these hypnotics, which should be gradually discontinued after a short time.

Neuralgic pains may persist and require for their alleviation galvanism or faradism. Ether may be used either as a spray or in combination with menthol and chloroform, forming an effective liniment. During the early weeks of convalescence general massage may with advantage take the place of too fatiguing outdoor exercise, but, as the strength returns, croquet, golf, cricket, and lawn tennis can with benefit be indulged in. Overfatigue, however, should be avoided.

After the patient returns to his home, the same watchful care as in the case of the alcoholic should be kept up for a year or more. The general health must be maintained. All faulty hygienic conditions in home life must be rectified. The dietary must be simple and nutritious, and care should be taken that digestion is carried on effectively without discomfort. Overstrain in business must be avoided. If practicable an outdoor life should replace an indoor occupation, and holidays should be frequent.

Still, the cares and stress of work are not the only difficulties with which the now-reclaimed morphinist has to contend. Paul Sollier describes the tides of recurrent craving which for many months beset the convalescent; periods of intense weariness with dyspeptic symptoms and desire for stimulation, and overwhelming psychical yearnings which, even more than intense physical pain, demand the sympathy and the assistance of the experienced physician.

Still further, in case of actual disease supervening, the patient must be warned not to permit the administration of morphin hypodermically. An injection given thoughtlessly may awaken cravings that have been stilled for a long period.

References for this chapter will be found following the references for Dr. Blackader's chapter on Food Poisoning, page 656.

CHAPTER III

PHOSPHORUS POISONING

A. D. BLACKADER

Poisoning by phosphorus is met with in both an acute and a chronic form. The latter is invariably of industrial origin; the former occurs almost always as the result of criminal intent, though very occasionally cases occur in which children by accident have swallowed match heads.

Before the invention of the match in 1833 phosphorus attracted little attention outside of the chemist's laboratory. Shortly after this its poisonous properties became more widely known, and, owing to its cheapness and the ease with which it could be obtained, poisoning by phosphorus became frequent both in Germany and France. Chamot states that in France alone between 1840 and 1880 there were 336 cases of criminal poisoning by this drug. As knowledge of it increased detection of the drug, when thus employed, became easy, and it ceased to be used with homicidal intent, but both in England and throughout Europe it was frequently taken by those desirous of committing suicide. During the ten years ending 1903 there were 80 suicides in England and Wales from phosphorus, which, for the most part, was obtained from the heads of matches made from the white, or, as it is sometimes called, yellow, phosphorus. This, which is the common form of phosphorus, is not only extremely poisonous when taken internally in a state of fine division, but its fumes during the process of match manufacture are very liable to induce necrosis of the jaw. The invention of the "safety" match in which this yellow phosphorus was replaced by the non-poisonous red phosphorus was a great advance. During the last few years legislation has been enacted in Great Britain, France, Germany, and other countries forbidding the use of yellow phosphorus in matches, and now in these countries the red phosphorus and the almost equally non-poisonous sesquisulphid of phosphorus are the only forms of phosphorus employed in match manufacture. Owing to this legislation there has been a great decrease in the number of deaths from phosphorus poisoning.

In America the common yellow phosphorus match is still largely manufactured and employed by the public. Very rarely, however, do

we meet with acute poisoning by phosphorus in this country. Only occasionally in the hospitals do we see some unfortunate immigrant, who, in a rash despondent mood, has had recourse to the poison which in this country still lurks in match heads.

Various phosphorus pastes are also in common use for the destruction of mice, cockroaches, and other vermin, and these, on rare occasions, have been used for suicidal purposes.

Lewin states that toxic symptoms have occasionally arisen from the therapeutic use of the drug. When given either in pill form or dissolved in oil, and in full doses repeated at short intervals, a cumulative effect may develop. Fatal results have been reported.

ACUTE POISONING

Commercial phosphorus is only slightly soluble in water, and volatilizes very slowly at body temperature, so that unless it reaches the stomach in a state of fine division it may pass through the whole of the alimentary tract without giving rise to serious symptoms. The rapidity of its absorption depends on the character of the stomach contents. Fat in any form dissolves it readily, and should the stomach at the time it is taken contain fat to any extent, the phosphorus will be dissolved and rapidly absorbed. Under favorable circumstances, it is only dissolved slowly in the secretions of the intestine. Owing to the time required for solution and absorption some hours almost invariably elapse after the poison has been taken before symptoms of poisoning make their appearance.

From two to three grains of phosphorus, if in fine division, is generally fatal. A small child is reported to have died after sucking the heads of two matches. Sixteen match heads are said to have given rise to fatal poisoning in an adult. In a case reported by Tardieu 101 matches were immersed for ten minutes in a cup of hot coffee. Only a portion of the phosphorus was removed, for, after drying, it was possible to ignite them, but the draught proved fatal.

TREATMENT

Treatment consists in the prompt evacuation of the stomach, first by means of emetics, and afterwards by passing a tube and washing it out with a solution of potassium permanganate, 1 in 500. Copper sulphate is strongly recommended as not only an emetic but also an antidote. Hare says that used carelessly it may do more harm than good. The majority of writers, however, recommend that it be given in five-grain doses every five minutes for two or three doses until vomiting is induced.

Black phosphid of copper, which is insoluble and comparatively innocuous, is expected to be formed. Fat in all forms, including even milk and the yolk of eggs, must be strictly interdicted for many days. The bowels should be kept moving freely by means of saline purgatives.

Oil of turpentine, provided that it be old, may be of some value. The turpentine originally recommended by Audaut was old French oil of turpentine, and this has a very definite action upon phosphorus, rendering it inactive. American rectified oil of turpentine, if fresh, is quite useless, but any old partly ozonized turpentine, especially if it has been exposed for some time to the air, will do good. Ten or fifteen minims should be given in emulsion every one or two hours. The patient must be kept in the recumbent posture for some time on account of the action of phosphorus on the heart. Alkaline drinks should be used freely to lessen the tendency to acidosis, and in severe cases the dose of alkali should be large to combat the acid intoxication, or alkaline solutions may be given intravenously to the same extent as in diabetic coma.

CHRONIC POISONING

Chronic poisoning is only met with in match factories as a result of inhaling the fumes of phosphorus; the most dangerous portions of the factories are the rooms in which the phosphorus composition is mixed, and those in which the dipping and cutting are done. Much of the work which used to be done by hand is now done to greater advantage by machinery, and it may now be said that in factories in which proper precautions are taken the health of the operatives does not appear to be seriously affected. In factories, however, in which ventilation is defective the fumes of the phosphorus are liable to be absorbed, and can be recognized in operatives by the garlicky odor of the breath. French writers speak of a group of symptoms which they term *phosphorisme*, met with in workers in match factories and due to a slow intoxication by the vapor of phosphorus. These symptoms are a cachectic appearance, presence of phosphorus in urine and saliva, anemia, albuminuria, and an indefinite amount of demineralization especially of the bony tissues. Such symptoms appear seldom to be met with in America.

The peculiar and important symptom, however, in chronic phosphorus poisoning is the development of necrosis in the jawbone, generally in the lower one. Writers in the middle of last century refer to the terrible disfigurement produced in a large number of the operatives by this necrosis, which extended in many cases to the neighboring tissues, and in a few cases attacked also the cranial bones, and was attended by such a penetrating, disagreeable odor as to render the sufferer almost an outcast. The poison appears to gain entrance through local areas of

lowered resistance in the mouth, such as any decay of the teeth involving the root canals, an accumulation of tartar around the neck of the teeth, or a condition of pyorrhœa alveolaris. The exact pathology of the necrosis is not definitely ascertained. The process appears to be associated with the presence in some cases of the tubercle bacillus and in others of the pyogenic cocci. Statistics show that the longer the workman has been exposed to the fumes the more liable is he to suffer. At the same time there is no doubt that it has a local origin, for no case of necrosis occurs without the previous existence of a carious tooth or exposure of the bone following an extraction. Experiments show that phosphorus fumes do not readily set up periostitis or periodontitis unless the periosteum has been damaged, and unless the exposure is prolonged. Dearden considers the constitutional impairment very important, and reports a case where the necrosis developed some months after the patient had left the factory. He claims that investigation shows that certain changes do take place in bone tissue as the result of prolonged inhalation of phosphorus fumes which render the bone less able to withstand infection.

The first symptom in the process is a toothache apparently confined to a single tooth; signs of suppuration soon develop and rapidly extend. If not treated promptly and thoroughly the disease spreads to the adjoining teeth, and is very difficult to check. The pus is extremely foul-smelling. The suppuration in severe cases burrows deeply, leaving great scars and much disfigurement. The general health suffers. Amyloid degeneration appears in the important viscera, and the patient dies not infrequently from tuberculosis or septicemia.

PROPHYLAXIS

Preventive measures must consist in securing for all operatives a minimum of exposure with a maximum of personal hygiene and the regular inspection at least once a month of the teeth of all who come in contact with the fumes.

All factories should be roomy and provided with exhaust air pumps so placed that the fumes of the phosphorus may be drawn off before they can be inhaled by the operatives. The operatives should be changed regularly from the more dangerous to the less dangerous portions of the work. No operative should remain continuously in rooms where the exposure is greatest. Effective washing facilities should be provided. No person should be permitted to start work in the factory without a certificate from a careful dentist that his teeth are free from caries, and until he is passed by the examining physician. Employees with diseased teeth should be required at once to visit a dentist, and absence from work should be enforced till a satisfactory certificate is obtained.

With these hygienic measures effectively carried out the manufacture of matches can be carried on with little danger of chronic poisoning making headway among the operatives. Reports from several large factories in America indicate that at the present the conditions in them are satisfactory. Nevertheless, we believe that, to insure the continuance of these hygienic conditions in all factories, governments should pass stringent regulations regarding the precautions to be employed in the manufacture of matches, and in time enforce the use of a non-poisonous modification of phosphorus to the complete exclusion of the very poisonous form which in America still enters into their manufacture.

TREATMENT

On the earliest indication of inflammation in or around the root of the tooth treatment should at once be commenced. All work in an exposed atmosphere must stop. The general health should receive prompt attention. Fresh air, a generous dietary, outdoor exercise in the sunshine should, if possible, be secured. The local trouble should be treated at first with antiseptics, but if suppuration ensue free incision and thorough drainage should be tried for a short time. If the symptoms do not improve, resection is the only recourse, but to secure the best results the general health should be in a fair condition before the operation is attempted.

CHAPTER IV

FOOD POISONING

A. D. BLACKADER AND ALBERT G. NICHOLLS

GENERAL CONSIDERATIONS

The healthy conduct of the digestive process depends, in the main, on the perfect correlation of three factors: proper food, the secretion of active digestive ferments, and the prompt evacuation of the waste materials. No one of these factors can be disturbed and become defective without modifying the action of the others and giving rise to symptoms of a modified intoxication. The character of the food to some extent affects the motor activity of the gastrointestinal tract. Food in too large amount or of irritating character will induce diarrhea; food in too small an amount and too concentrated in bulk induces constipation. Insipid and unappetizing foods fail to stimulate properly the digestive secretions; imperfect and diminished secretion, by impairing digestion and prolonging the time necessary for its completion, permits the growth and increased activity of bacteria, and indirectly gives rise to irritation of the intestinal mucous membrane. Pain, flatulence, diarrhea, and general systemic disturbances may result. Variations in the relative proportions of the different digestive ferments concerned are probably of little moment, inasmuch as deficiency in one may be readily compensated by increased activity in the others.

The alimentary tract, from mouth to anus, contains bacteria in great numbers and of considerable variety. Ordinarily these are nonpathogenic, if, indeed, certain of them are not beneficial to the economy. On occasion, however, their numbers may be so increased and their virulence so exalted that they produce pathogenic effects. Notably is this the case when there is any obstruction to the free evacuation of the intestinal contents. Of this we have experimental proof. Caplewsky and Frazier (17), for example, found that if the cecum were closed in the rabbit peritonitis rapidly supervened. Posner and Lewin also (55) showed that closure of the rabbit's rectum led to the appearance of the *B. coli* in the various organs in the course of a few hours. Macaigne (42) also demonstrated

that a strain of *B. coli* taken from the bowel and found to be innocuous becomes highly virulent when that same bowel is experimentally occluded. This being so, it is not hard to understand why that very common condition, chronic constipation, is so harmful. The well-known systematic effects of this affection, headache, mental dulness, *malaise*, and earthiness of the skin, are, no doubt, attributable to the slow absorption of toxins from the lumen of the bowel.

It is to be noted, however, that numerous toxic substances, potent for harm, are regularly produced in the course of the natural physiological processes of digestion. Among these may be mentioned:

(a) Those derived from the disintegration of proteins: albumoses, peptones, indol, skatol, phenol, leucin, tyrosin, fatty acids, acetone, ammonia, cystin, carbon dioxid, sulphuretted and carburetted hydrogen, methyl mercaptan.

(b) Those derived from carbohydrates: formic, acetic, propionic, butyric, valerianic, lactic, and succinic acids, acetone, and various gases.

(c) Those derived from fats: fatty acids and glycerin.

Under normal circumstances these substances are not absorbed in sufficient quantity to cause disturbance either before or during their elimination, but if digestion is imperfect and peristalsis is unduly checked these toxic substances are produced in increased amount owing to abnormal bacterial activity, and their absorption will give rise to symptoms of poisoning.

Not only may these toxic products of bacterial activity and of imperfect digestion be absorbed, but the bacteria themselves may gain an entrance into the tissues of the host and set up not only a systemic intoxication, but an infection as well. A foodstuff, even if it be in itself not toxic, may by mechanical or chemical action so lessen the natural protecting power of the bowel, by damaging its lining membrane, that it invites the untoward action of the contained bacteria. In all cases of food poisoning this factor has to be borne in mind. When foods are not only irritative in character but contain infective agents as well, this action is, of course, intensified. That poisoning does not occur more often is due in great measure to the fact that the natural daily movement of the bowels is as a rule sufficient to remove any dangerous excess of bacteria and their products. Diarrhea is generally nature's method of getting rid of offending matter in the bowel. Up to a certain point it is necessary and useful. If excessive and uncontrolled it may become dangerous.

More than this, evidence is accumulating to show that certain types of foodstuffs, if taken in excess of the needs of the organism and of its powers of digestion, are competent to set up abnormal metabolic processes which result in poisoning of the general system. The cyclic vomiting of children, the acidemia of diabetes, and the acidosis that occasionally occurs in the course of fevers may be cited in this connection. Finkel-

stein (26) has drawn attention to the fact that diarrhea, rapid respiration, and psychic depression are occasionally met with in infants who are overfed with fats and sugars. This is never a primary intoxication, but is apparently grafted upon some previously existing nutritional or digestive disorder. In such cases he considers that we have to do with an alimentary or metabolic intoxication.

It is clear, therefore, that a wide range of systemic disorders is possible as a result of disturbed digestion, abnormal fermentation, and impaired motility occurring in the alimentary tract. These disorders have by some been grouped under the faulty term of autointoxications, and will be dealt with elsewhere in this work.

In considering the various forms of foodstuffs which may give rise to systemic poisoning, we may recognize first a small group of foods which, while of excellent quality and digestible and wholesome for the majority of individuals, do produce toxic symptoms in a few, owing apparently to some personal idiosyncrasy. Eggs, veal, and even milk may in certain persons produce very distressing symptoms, and there are many who cannot partake of shellfish, cheese, or strawberries without suffering from urticaria.

A more important group of substances which on occasions have been used as food contain an endogenous poison, i. e., a poison that has been developed in the substance and is essential to it. Personal idiosyncrasy plays no part, excepting in so far as it may modify the symptoms. Substances that contain such poisons can in no proper sense be termed foods; nevertheless they have not infrequently been used as food, in ignorance of their real nature or in mistake, owing to their superficial resemblance to food substances of recognized wholesomeness. It is well known, for example, that certain fish, especially some found in the West Indies and Japan, are extremely poisonous, even when quite fresh. Fish with very gaudy coloring are particularly suspicious. Many mollusc and fish also manifest poisonous properties during certain phases of sexual life. The term "siguatera" has been applied by Blanchard to this group of fish poisonings.

The largest and most important group of poisonous foodstuffs includes all those foods in which exogenous poisons are met with; poisons that have been for the greater part introduced by accident and are in no way inherent in the food itself. These poisons may be included under four groups:

1. Metallic poisons.
2. Adulterants and preservatives.
3. Animal parasites.
4. Vegetable organisms, e. g., bacteria and the higher fungi.

Outbreaks of food poisoning due to contamination of foodstuffs by

metals are relatively uncommon. The agents which have been shown at different times to be responsible are lead, arsenic, copper, tin, antimony, and zinc. Water which has to be conveyed some distance in lead pipes has in some instances been the cause of poisoning. (See article Toxicology.)

Preservatives, such as boracic acid, salicylic acid, and formalin, are sometimes added to foodstuffs, notably to meat, fish, vegetables, and milk. While it may be debated whether the use of these antiseptics in small amounts is injurious to health or directly dangerous to life, most of them lessen the digestibility of the food and make it possible to utilize an inferior quality of material and to preserve it unduly long. For these reasons it is desirable that their employment should be either forbidden or strictly limited by law.

The various anilin colors added to sauces, candies, and cake may also prove injurious.

The deleterious agents of animal origin that may be introduced with the food are mainly the *trichina spiralis* and the various tapeworms and other intestinal parasites. It is now well recognized that the *trichina* may infest the hog, so that a very real danger to health and even life exists in the case of all those who use pork imperfectly smoked or cooked. In all cases of poisoning from pork or pork sausage this parasite should be carefully searched for. The various intestinal worms, while almost as important, will be dealt with elsewhere in this work.

By far the most frequent and potent causes of food poisoning, however, are the vegetable organisms, parasitic and saprophytic. The diseases known as ergotism and lathyrism, both of them practically unknown in America, are attributable to the contamination of rye and pulse by certain of the higher fungi or molds. Fission fungi or bacteria may infest food products of all kinds: water, milk, beer, fish, meat, oysters, bread, cheese, ice cream, and vegetables. All animal and vegetable substances, unless suitably prepared, inevitably undergo fermentation and putrefaction. This result is brought about by bacteria which proliferate in myriads in these substances. The peculiar effects produced by them are the result of many simple and complex chemical processes which have an eventual termination in the reduction of the highly complicated organic compounds into simpler inorganic constituents. While this is the case it must not be assumed that the great bulk of the microorganisms at such work are necessarily harmful to the individual making use of the food in which they are present. Many persons, for example, prefer their game "high" and their cheese old, and eat both without poisonous consequences. Nevertheless there is a relatively small number of bacteria capable of producing toxic substances under these circumstances, and when such are present poisonous symptoms will develop.

Selmi, in 1874, was the first to separate from food in the course of

putrefactive decomposition several poisonous alkaloids closely resembling the intensely poisonous alkaloids of vegetable origin, and it seemed quite natural to suppose that these toxic bodies, or ptomains, were the direct cause of the poisonous symptoms arising after the ingestion of contaminated food. But it is now recognized that the great majority of ptomains are only feebly, if at all, poisonous, and in the majority of cases in which poisoning has followed the ingestion of certain foods investigation has shown that the poisoning was not attributable to these ptomains but due to the presence of bacteria introduced by eating the flesh of animals which before death suffered from bacterial infection. Still some few of these ptomains are distinctly toxic and have been known to be the cause of outbreaks of food poisoning. Among these may be mentioned trimethylamin, found in herring brine; cholin, derived from decaying nerve matter; neurin, met with in meat and fish; muscarin, found in decaying fish and also in poisonous mushrooms; sepsin, in putrid beer; tyrotoxin, isolated by Vaughan from cheese and other milk products, and mytilotoxin, the most deadly of all, found in mussels.

While it is true that ptomains are directly traceable to bacterial activity, yet they are not specific; that is to say, a particular species of bacterium is not necessarily or invariably associated with the formation of a definite alkaloidal product. In view of this fact it is obvious that the cause of many cases of food-poisoning and of the intoxication in various infectious fevers must be looked for in some other direction. The study of snake venom proved that the active toxic principle is of an albuminous nature. The poisonous elements in the jequirity seed and the castor oil bean are also proteid. In 1889 Brieger and Fraenkel, working with the cultural products of the diphtheria bacillus, obtained extremely poisonous precipitates of proteid character, which they accordingly termed *toxalbumins*. Analogous bodies have also been obtained from other microorganisms. It was soon discovered, however, that those so-called toxalbumins were not chemical entities, but were really admixtures of an inert protein and an active poison, nonproteid and nonbasic. This latter is technically termed a *toxin*. It is beyond question that they are, directly or indirectly, responsible for the untoward results in cases of infection.

From all the available evidence it must be concluded that most of the outbreaks of food poisoning have been due to the action of bacteria and that they produce their harmful effects by means of the toxins which they elaborate. Certain bacteria, notably *B. botulinus* (the cause of some cases of meat poisoning), are unable to grow at the body temperature. It follows that the poisons that they produce must be formed in the food before it is ingested. Such bacteria are practically saprophytes, and the effects produced will be in direct proportion to the amount of the infected food consumed. Certain others can grow both at room temperature and

body heat. While, therefore, they produce toxins in the food before is eaten, they may also continue to do this within the intestine, and in ch cases we have to deal with both an intoxication and an infection.

other cases the bacteria introduced are specifically pathogenic, and hen taken into the system with food, even in small numbers, are capable setting up a definite infection. Examples of this form are met with epidemics of typhoid fever and of cholera, due to contaminated milk or ater.

The majority of cases of food poisoning are cases of food infection.

the smaller number the food may have been at the first perfectly wholesome, but has become accidentally contaminated by improper handling, but in the larger number it must be attributed to an infection existing in the animal at the time it was killed. One writer states that lly four-fifths of the meat-poisoning epidemics have been shown to be ie to the ingestion of the meat of animals suffering previous to their being lled from bacterial infection. The bacteria found to be responsible for e various epidemics are very numerous, and their clinical manifestations vary within wide limits. Several of the toxins are very difficult to destroy. The exposure of the food to a temperature of 80° C., or even to e boiling point, for a period as long as thirty minutes to an hour and half, is not sufficient to destroy some of them. It follows, therefore, at, despite the greatest care in cooking, safety cannot be assured unless e most searching inspection of all forms of animal food intended for man consumption be carried out. Recent investigations by Drs. Klein and Durham show that it requires very careful examination to detect with rtainty the microorganisms which lead to poisonous symptoms.

Investigations have also been carried on to determine the possibility toxic changes taking place in food in the absence of any bacterial activity. Certain intracellular ferments appear to be widely distributed in animal tissues, which, acting upon the proteid and nucleoproteid of the animal cell, produce decomposition products very similar to those produced by heat, acids, and bacteria. Such changes appear to be very feebly toxic even on experimental injection, so that the danger of food thus tered is very slight. On the other hand, such changes may not infrequently be distinctly advantageous, for meat that has hung for some time more easily digested and is more sapid than fresh meat.

SPECIAL FORMS OF FOOD POISONING

Poisoning by Eggs.—It is a fact that not a few persons cannot, or imagine they cannot, eat eggs, and feel themselves distinctly uncomfortable after using this article of diet; as they express it, they find eggs for them be “bilious.” While it is exceptional to find serious results following

the eating of eggs, a few cases in which toxic symptoms occurred have been reported. Jonathan Hutchinson has related a case in which the ingestion of the smallest amount of egg produced violent symptoms, resembling those of an irritant poison. The clinical features, as portrayed in the cases reported by S. J. R. Clemens (20) and D. J. M. Miller (45), are vomiting, fever, intense prostration, and even collapse; and, in some, an urticarial and petechial eruption. Cases of poisoning have also occurred from the use of the white of egg alone. These untoward results have occurred in cases where the eggs were undoubtedly quite fresh, and must be explained on the ground of some special idiosyncrasy or form of anaphylaxis in those so affected.

The treatment consists in emptying the stomach, unless this has been done thoroughly by the vomiting which supervenes, and clearing out the bowels with purgatives, of which the best is a mild mercurial followed by a saline purge.

Poisoning by Meat (*Kreatotoxismus*).—Butcher meat and canned foods of various kinds may be dangerous to health in more than one way. The animals in question may have been slaughtered while suffering from infectious disease, such as anthrax, tuberculosis, puerperal fever, and paratyphoid. If such meat be eaten raw or imperfectly cooked the risk of the infection being transmitted to the consumer is very considerable. In such cases we have to deal, not only with a toxemia, but also with an infection. Even thorough heating does not render such food innocuous, for certain of the organisms, notably the *B. paratyphosus* and the *B. enteritidis* of Gærtner, produce toxins that are thermostable. The bacillus is killed but the toxin remains. As a rule, however, subjection of the food to high temperature is sufficient to render it harmless, even if derived from an objectionable source. Most of the bacteria responsible for food poisoning are readily killed by heat and their toxins destroyed. For this reason canned meats are rarely the cause of outbreaks of food poisoning. When such occur it is usually found that the can is defective and the contents more or less putrid from the admission of air. In a number of instances contamination of food has been due to careless or improper methods of preparation or preservation, permitting meat, originally of good quality, to become infected by harmful bacteria.

The cold-storage system introduced of late years has distinctly increased the risk from infected meat. Before this system was introduced all food was reasonably fresh when it reached the table for the consumer. The circumstances demanded that all food had to be promptly distributed in the comparatively near vicinity of its production. Diseased and dangerous meat of all kinds could be readily detected, and careful inspection by health officers minimized the risk. With the advent of cold-storage methods this has been changed. When large amounts are being stored at once, inspection is more difficult, and when damaged food once enters it is prac-

tically impossible to trace its history, or afterwards to recognize it. A special risk exists in the case of game and birds of various kinds, which generally are stored away "undrawn." Where the entrails are thus preserved with the flesh the risk of contamination must be great. Such methods, to say the least, are filthy and unsanitary.

The flesh which most commonly causes trouble is that of cattle and hogs. Horse flesh is less frequently at fault, and fish and chicken very exceptionally. Mutton has usually been regarded as above suspicion, but Bryson, a few years ago, reported some cases of poisoning in which this meat was the agent; bradycardia was a marked feature. Pork, in its various forms, is often a cause of poisoning, because it is so frequently preserved by salting and smoking, both of which processes secure only an imperfect antisepsis; and, moreover, because in certain countries it is eaten raw.

It is to be noted that the appearance, taste, and smell of meat are not always safe guides in regard to its wholesomeness.

The more important forms of meat poisoning may now be considered in greater detail.

POISONING DUE TO BACILLUS BOTULINUS.—This microorganism is a frequent cause of meat poisoning. Beef, ham, veal, corned beef, and goose, infected by it, have all been causes of outbreaks. Ham and the larger sausages are more likely to be invaded, as they are apt to be imperfectly cured in the center. Blood and liver sausages are said to be the most dangerous. An outbreak of poisoning due to this bacillus, which was carefully studied and reported by von Ermengen, of Belgium, is very illustrative. Thirty-four persons were at first affected, all members of a society who had partaken of a certain ham for supper. A few days later others were attacked with the same symptoms. Three died within a week. The animal from which the meat had been taken was quite healthy, and a portion of the meat had been eaten shortly after it was killed without ill effect. The rest of the meat was salted and packed away. The brine proved to have been both dilute and insufficient in quantity, for only the bottom ham was immersed in the liquid. The uncovered portions of the meat were eaten without any untoward results, the lower ham was the one which had caused the poisoning. The deficiency in salt had allowed the growth of microorganisms, and the exclusion of air from the lower and poisonous ham had permitted the development of an anaerobic variety, which was isolated and named, by von Ermengen, *B. botulinus*. Portions of this ham fed to mice, white rats, kittens, guinea pigs, and monkeys caused death. Subcutaneous injections of one millimeter of a maceration (1-5), killed mice; larger doses were fatal to rats, doves, and cats. Rabbits were extremely susceptible, while frogs, dogs, and chickens were refractory. The liquid obtained by filtering macerations through porcelain was as powerful as the maceration, proving that a soluble toxin existed in the

ham. The experimental animals which died did not exhibit the special germ in their organs. It was therefore regarded as a saprophyte notably toxicogenic.

The symptoms, in the main, are referable to the central nervous system. Diarrhea and vomiting occur to a slight extent only, or are altogether absent. Obstinate constipation, with retention of urine; blurred vision; dysphagia, and aphonia are prominent features. Death results from paralysis of the medullary centers.

In the outbreak reported the absorption of the poison was apparently slow; the first symptoms did not appear until 24 hours had elapsed, and, in a few, not until 36 hours or longer. Gastric pain, with vomiting, ushered in the attack. All but two cases presented marked constipation. The mucous membranes were congested, and, in some, there was such an abundant secretion of viscid mucus in mouth and throat as to lead to violent attacks of coughing and a sense of suffocation. Thirst was unquenchable. Disturbance of vision was a marked feature in all, and was associated with dilatation of the pupils, diplopia, and ptosis of the lids. Paralysis of the muscles of the throat and larynx occurred in some cases, resulting in aphonia. Extreme muscular weakness was general and persistent for some weeks. Anuria was observed in a few cases. The pulse was very weak, and its frequency below normal. The respiration was not disturbed, and the temperature remained normal. In the fatal cases delirium or coma set in before death. In the more favorable cases the intellect remained unimpaired, but convalescence was tedious and many weeks, and, in a few cases, even months, elapsed before strength was regained.

Treatment must be adapted to the stage of the disease. We have, in the first place, to deal with a toxemia due to the absorption of a powerful soluble and diffusible toxin. Our efforts, therefore, should be directed to preventing further absorption, to promoting elimination, and to supporting the patient. The stomach should be washed out at once with a dilute alkaline solution, followed by a solution of potassium permanganate, 1 in 1,000. The bowels should be unloaded with calomel and saline purgatives, and the action of these may be hastened by means of high enemata containing turpentine. Subcutaneous or intravenous salines should be exhibited freely. They have the double advantage of diluting the toxin and promoting elimination, and of relieving the intolerable thirst. If swallowing be difficult or impossible, food should be administered by means of the stomach tube. All procedures conducive to the comfort of the patient should be adopted. The paralysis of the muscles of deglutition predisposes to an aspiration pneumonia, consequently the care of the mouth is of great importance. Frequent sponging of the body is desirable.

An antitoxic serum of considerable potency has been prepared, which can be obtained from the Institute of Infectious Diseases at Berlin. On

this side of the Atlantic this aid is at present unavailable. Cases occur only at rare intervals, and antitoxic sera soon deteriorate. To be of value the remedy must be used promptly and possibly subdurally.

In the later stages of the disease treatment is largely symptomatic. The patient should be kept quiet and in a recumbent position, as any sudden exertion may result in fatal paralysis of the heart. Strychnin and digitalis are demanded; alcohol will frequently be of benefit. For the ocular paralyses electricity may be of value after the acute symptoms have subsided. A weak galvanic current (1 milliampère) should be employed for four or five minutes, applying the anode to the nape of the neck and rubbing the cathode gently over the closed eyelids. Stronger galvanic or faradic currents may be employed elsewhere.

In sharp contrast to the preceding type of intoxication, in which the central nervous system is chiefly affected, is the type of poisoning developed by members of the colon, proteus, and typhoid groups, in which the symptoms are chiefly gastrointestinal, and may merge into an actual systemic infection. The most important food poisonings in this group have been caused by *B. enteritidis* of Gærtner, various subspecies of colon, and the *B. paratyphosus*.

POISONING DUE TO *B. ENTERITIDIS*.—This organism was first isolated by Gærtner (1888) from meat which had poisoned a large number of persons; it appears to be somewhat closely related to the *B. coli*, but differs in not producing indol and in being more pathogenic for experimental animals.

The animal whose flesh proved to be so poisonous had suffered from diarrhea for some days previous to its being slaughtered. Those who ate the meat cooked were affected as well as some who ate it raw. Out of 58 persons attacked one died. Sterilized cultures were highly poisonous for mice and guinea pigs. Thus, unlike the toxin of *B. botulinus*, cultures of Gærtner's organism retain their power even after boiling for several hours. The toxin appears to be intracellular.

The symptoms produced were a very marked gastroenteritis, with vomiting, diarrhea, abdominal pain, and intense prostration. Outbreaks which appear attributable to this microorganism have been reported by Lubarsch, Karlinski, Fischer, Johne, Poels and Dhont, Holst and Gunther; so that it appears to be widely distributed and may be frequently met with.

Instances have also been reported in which the consumption of canned meat has given rise to symptoms of poisoning by this organism. In one case, out of nineteen persons in a family, twelve developed symptoms of poisoning after partaking of the meat; while those who did not use it escaped. The blood of the affected individuals gave a strong agglutinating reaction with a stock culture of *B. enteritidis*. Bacteriological examination of the food failed to show the presence of living bacteria. The organisms appear, therefore, to have been destroyed by heat in the process of canning, though the toxins remained. The fact that the symptoms ap-

peared promptly after the consumption of the food indicated that a toxemia rather than an infection had been present.

In treatment our first efforts should be directed to securing prompt evacuation of the stomach, either by means of an emetic or by passing a tube and repeatedly washing it out with a weak alkaline solution; full doses of castor oil or saline purges should follow. Medication afterwards should be directed to relieving the pain and soothing the inflamed stomach and bowel. For this purpose bismuth and opium in some form should be administered, and, if thought wise, may be combined with one or other of the intestinal antiseptics. High rectal injections of protargol (1-1,000) may be of some value. Although the poisonous factor is a toxin and not a living organism, yet this toxin is such an irritant to the gastrointestinal mucosa that infection by bacteria from the alimentary tract is not an infrequent accompaniment of the disease.

POISONING BY *B. BRESLAVIENSIS*.—Outbreaks of poisoning due to this organism appear to have occurred in Morseele, Ghent, and Breslau. At Morseele eighty persons were attacked, of whom four died. At Breslau about eighty were affected, but none died. In the Morseele and Breslau epidemics the cattle supplying the meat had suffered from fever and several had diarrhea. The organism of these outbreaks was shown to be related to the colon group, but it neither produces indol nor coagulates milk. It resembles the Gærtner bacillus in that its toxin is resistant to heat. Sterilized and nonsterilized cultures and infected meat, when fed to or injected into mice and rabbits, proved fatal; dogs and cats were refractory.

The symptoms were fever, severe gastroenteritis, and, in the severer cases, ecchymoses of the skin and disturbance of vision. In children convulsions were observed.

POISONING BY *B. FRIEDEBERGENSIS*.—Some thirty persons, of whom one died, were poisoned by eating sausage made from the flesh and liver of a horse which appears to have been diseased before it was killed. Macerations from the infected sausage injected subcutaneously into rabbits, mice, and guinea pigs proved fatal. From the infected animals a short bacillus was obtained. One feeding of the sausage given to mice killed one of them in eight days, and from it the same organism was recovered. Pure cultures, whether given by the mouth or injected subcutaneously or intravenously, proved fatal to the animals tested. The bacillus closely resembles the *B. coli*, but does not produce indol nor coagulate milk. Unlike *B. enteritidis*, the toxin was destroyed by boiling.

The symptoms began in some cases within half an hour, but in the majority not till several hours had elapsed, and, in a few, symptoms did not appear until twelve and even twenty-four hours after partaking of the food. The clinical features were nausea and vomiting, chills, fever, head-

ache, thirst, and abdominal pain. Intense muscular weakness was a common feature. Vision was not disturbed.

POISONING BY THE BACILLUS SUISEPTICUS.—Pouchet, in 1897, described an epidemic due to eating decaying pork, from which he isolated an organism which was probably that of swine-plague. Dizziness, headache, fever, vomiting, diarrhea, and a generalized erythema were the prominent features.

POISONING BY B. PROTEUS.—Quite a number of cases of poisoning by infected beef have been recorded in which the causal agent was in all probability the *B. proteus* or some variant of it. Such are the epidemics described by Levy (1894), Wesenberg (1897), Silberschmidt (1899), and Pfuhl (1900). The organisms recovered have been identified with the *proteus vulgaris* and *proteus mirabilis*. The dead bacilli are as toxic as the living, indicating that the toxin is largely intracellular; heating to 60° C. destroyed the toxin.

The symptoms are severe headache, dizziness, intense colic, diarrhea, and marked muscular weakness. The intestinal evacuations are greenish or brownish in color and very offensive.

POISONING BY B. PARATYPHOSUS.—Paratyphoid infection frequently simulates closely true typhoid fever. As a rule, however, the paratyphoid runs a milder course, and is much less fatal. The reason for this, in part, is that the main lesion is a gastroenteritis without ulceration of the lymphoid elements of the bowel. The differential diagnosis can only be made, in many instances, by means of the agglutination reaction. The *B. paratyphosus* will not agglutinate with typhoid serum, but will do so with that of the host. Occasionally infection with the *B. paratyphosus* leads to very acute symptoms, and we have all the features of a food poisoning. There may be a short incubation period of from two to forty-eight hours, after which giddiness, headache, vomiting, colic, and diarrhea set in. The diarrhea is usually profuse, and there is a moderate elevation of temperature. Prostration is marked. This form tends to recovery providing that the offending agent be removed. Mild cases terminate favorably in two or three days, while the severer ones may take as many weeks. The mortality is about three per cent.

The organism is intermediate in its cultural peculiarities between *B. typhosus* and *B. coli*, and several strains of it, differing in minor points, have been isolated. The toxin is powerful and is very resistant to boiling.

Treatment in all these cases must be eliminative, and afterward symptomatic. In the acute forms of gastrointestinal irritation, which supervene shortly after the ingestion of infected food, emesis followed by gastric lavage is indicated. A dose of calomel should be given early and followed by castor oil or a saline purge. The bowels should be thoroughly evacuated, and, to favor elimination, high injections of large amounts of hot

normal saline solution may be employed. Afterwards bismuth and opium may be administered, combined with intestinal antiseptics, but both the opium and the antiseptics should be used cautiously. Food for the first few days must be liquid in character, very digestible, and very moderate in amount. It may consist of albumin water, milk with lime water, or barley water, malted milk, water gruel, and similar articles. Later, broths and beaten eggs may be permitted. Stimulants are frequently demanded; strychnin, caffein, and camphor, may be given hypodermically, and a moderate amount of alcohol is frequently necessary. The more protracted cases should be treated on the lines of typhoid fever.

The following types of disease produced by meat appear to demand a brief reference, as the symptoms may be of an acute character:

POISONING BY B. PNEUMONIÆ (Klein).—An epidemic of pneumonia occurring in Middlesborough, England, resulted in four hundred and ninety deaths. Ballard, who investigated the matter, concluded that some individuals had been infected by eating imported bacon and had transmitted the disease to others, who had not partaken of the infected food. In the lungs Klein (35) found an organism, differing from both the Friedländer and the Fraenkel forms, which he termed *B. pneumoniæ*. Samples of the suspected bacon when fed to rodents caused death with lesions similar to those in man. During the course of the investigation an epidemic of pneumonia broke out among animals, and in these the same microorganism was recovered.

POISONING BY B. ANTHRACIS.—See Vol. II, Section I, Chapter XIX.

Poisoning by Fish (*Ichthyotoxismus*).—In countries such as Russia, where fish forms a staple article of diet, outbreaks of acute poisoning from this source are frequent. In America cases of poisoning are generally due to the canned product.

The flesh of fish may be primarily injurious, or become so in several ways; certain varieties possess glands which secrete substances poisonous to man, though their flesh may be otherwise harmless. In other cases the flesh becomes injurious owing to some peculiarity in the food of the fish, or to an infection of the living fish by pathogenic bacteria. In still others the flesh acquires its dangerous properties during the spawning season. The roe of the barbel (*cyprinus barbus*) the liver of the swordfish (*xiphias gladius*), and the liver and ovaries of members of the tetradon group have on several occasions given rise to fatal poisoning. An alkaloidal substance, resembling curarin and named fugin, is said to be responsible for the symptoms. As a rule, the dangerous fishes are found in tropical and subtropical regions. Two types of poisoning have been described; in the one the symptoms are chiefly gastrointestinal, and in the other the nervous symptoms are the most prominent.

Barbel cholera may be taken as an example of the former. After a

latent period of four or six hours nausea, vomiting, colic, and diarrhea supervene, with a weak and rapid pulse and intense prostration.

A burning sensation in the throat is a very marked feature. In these cases the stomach should always be washed out, even if vomiting has previously taken place. A smart purge of castor oil or saline should be given. The prostration may be relieved by the application of heat and by the administration of alcohol, strychnin, caffein, or camphor. Demulcent drinks, such as linseed tea, are useful. Opiates should be given to relieve the pain and to counteract spasm.

In the nervous form the symptoms resemble poisoning by curare. They are very acute, developing within a few minutes after ingestion of the fish. The chief features are giddiness, vomiting, numbness, dyspnea, and cyanosis. Muscular prostration is extreme, and aphonia and, in some instances, diminished control of the sphincters may develop. Collapse rapidly sets in, followed by death within two or three hours. The treatment should be similar to that of curare poisoning: gastric lavage, purgation, stimulation, inhalations of oxygen, and artificial respiration.

Education of the general public in regard to the dangers to be apprehended from certain fish, and the prohibition of the sale of fish during certain seasons, are the more important measures to be taken to prevent this form of poisoning.

It is well known that fish are liable to epidemic diseases. In 1893 Charrin isolated several microorganisms that were pathogenic for fish. In investigating an epidemic among trout in 1894 Emmerich and Weibel described as the etiological factor *B. salmonicida*. In 1895 thirty people died in about two days as the result of eating fish taken from an aquarium. As some of those which remained proved to be sick, Sieber-Schoumow made a careful study of them and obtained from the living and from some of the dead fish a toxicogenic microbe which she called *B. piscicidus agilis*. From cultures she isolated cadavarin and other ptomains. The same germ was found in the water and the discharges of two patients with choleraic diarrhea. Wyss, in 1893, in his investigation of an epidemic that had broken out among the fish in Lake Zurich, isolated a bacillus which he considered to be the *B. proteus vulgaris*, though it differed in minor points, such as the noncoagulation of milk and the decomposition of urea. An epidemic of malignant edema described by Sir Thomas Stevenson was apparently due to eating sardines which were infected by this microorganism. In other cases the *B. paratyphosus* has been recognized as the cause of epidemic poisoning due to the eating of infected fish. In not a few cases fish becomes dangerous to health owing to the fact that it has become more or less putrid or has become infected from careless handling. Mackerel, herrings, and carp have been known to develop poisonous properties when not quite fresh, and, indeed, any fish should be looked upon with suspicion and rejected if the eyes are not

bright, the gills pink, and the flesh firm, and especially if there is any unpleasant odor. Fish improperly salted, notably salmon, herrings, and sturgeon, may acquire poisonous properties.

Canned fish has not infrequently caused trouble. This is especially liable to occur when the tin has been "blown." Ballard has reported cases of this kind. Of five persons affected two died. At the autopsies Klein found necrosis of the gastric mucous membrane, fatty degeneration of the liver, and nephritis. Mice fed on some of the contents died, but no germs could be found in their blood. Evidently the toxin was produced by a saprophytic organism.

In a case which recovered, reported by Vaughan (67), he isolated from the salmon an anaerobic micrococcus which proved to be highly toxic. The symptoms were nausea, vomiting of a bile-stained fluid, colic, and a generalized scarlatiniform eruption. The pulse was 140 and the temperature 102° F. The patient was ill a week, but recovered.

POISONING BY SHELLFISH.—Oysters, clams, cockles, and mussels are the usual offenders. A number of epidemics of *typhoid fever* have been traced to the use of oysters which had been contaminated by sewage.

At times the symptoms of poisoning by oysters are most acute and have ended fatally. Brosch, in 1896, reported the case of an officer who died in twelve hours after eating oysters, which, at the time, were noted to have had a bad taste.

Mussel poisoning (mytilotoxismus) is the most fatal of all the forms which are attributable to food, and, moreover, presents a greater variety of symptoms than any other form. Three clinical types have been described: (1) a gastroenteritic form, with nausea, vomiting, and diarrhea, much resembling the ordinary meat poisoning; (2) an exanthematic form, in which there is a sensation of heat and itching in the skin, followed by the appearance of a papular or vesicular eruption; and (3) a nervous form, not unlike what occurs in poisoning by *B. botulinus*. The prominent features are giddiness, headache, constriction of the throat, difficulty in speaking, numbness and coldness of the limbs, and general muscular weakness. The pupils are dilated and fail to react; the pulse is relatively infrequent; and the temperature is not elevated.

The symptoms are due to a highly poisonous ptomain mytilotoxin, first isolated by Brieger from mussels which caused an outbreak of poisoning at Wilhelmshaven. The mussels were obtained from brackish water, but curiously lost their toxic properties when removed to pure sea water.

The treatment is symptomatic, care being exercised not to intensify the gastrointestinal irritation, or to interfere with elimination. The treatment otherwise should be conducted on the lines indicated above.

Poisoning by Milk and Milk Products (*Galactotoxismus*).—Milk is one of the best culture media for bacteria that we possess. Under ordinarily favorable conditions of production and transportation, when it

reaches the consumer it contains large numbers of microorganisms (10,000-3,000,000 to the cubic centimeter). These must necessarily give rise to deleterious changes in the milk. Many of the organisms found in milk are harmless, if not indeed beneficial, but some of them, *B. coli*, for example, which is frequently present, may induce diarrhea and other gastroenteric disturbances. The summer diarrhea of children, which is so prevalent in the cities of Canada and the United States, is, in some degree, traceable to stale or contaminated milk. Many of the cases are a true dysentery, due to various forms of the *B. dysenteriae*. As a rule, the result of bacterial activity, especially in warm weather, is to sour the milk, and it is seldom that sour milk gives rise to poisoning, as the lactic acid bacillus, the active agent in the process, appears to check the development of the more poisonous forms. The comparatively low temperature necessary for pasteurization kills the lactic bacillus, but does not permanently inhibit the spore-bearing and putrefactive forms which may exist in the milk. Consequently pasteurized milk, if kept for days, and under unfavorable conditions, putrefies rather than turns sour, and this change may be advanced before it is noticed by the person using it. This explains why certain authorities on infant feeding rather deprecate the general use of the pasteurized product. All alkaline or amphoteric milk, if old, is apt to be dangerous owing to the development of pathogenic bacteria.

In exceptional instances milk may be infected in the udder; if the cow is suffering from septicemia, from general tuberculosis, or from a local suppuration, the germs from any of these infections will probably be found in the milk in sufficient numbers to render the use of such milk fraught with danger. Milk may also be contaminated during the course of milking, during storage, and in transmission to its destination. The importance of stringent laws regulating the conduct of the milk traffic in every city is not yet universally appreciated. Cleanliness of the animals, of the stables, and of the hands of those who do the milking and the complete protection of the milk from possible contamination by dust and by manure should be secured. For many reasons it is preferable to milk by machinery. After it is drawn, the milk should be immediately chilled, aerated, and preserved in absolutely clean containers, surrounded by ice and maintained at a low temperature by means of refrigerator cars and delivery wagons till it reaches the consumer. Only by means of a rigid inspection to secure the carrying out of all these details can a pure milk suitable for an infant's consumption be obtained in any city.

Not a few epidemics of *typhoid fever* have been traced to contamination of milk by infected water, not necessarily in the practice of watering the milk, but from the mere washing of the cans in polluted water. Cases of *acute poisoning* due directly to milk and its derivatives, and analogous to those caused by meat, have been reported. Milk itself, cheese, ice-cream, cream puffs, and frozen puddings or custards, made with contami-

nated milk have been the agents. In most of these cases the poisoning has been due to the presence of a toxic albumose derived from *B. coli*. In a few cases, however, *tyrotoxin*, a highly poisonous substance isolated by Vaughan in 1885, first from cheese and later from milk, has been shown to be present.

CHEESE POISONING (*Tyrotaxismus*) occurs not infrequently, and its peculiarities have consequently been carefully studied. Vaughan and McClymonds have shown that toxicogenic bacteria are present in nearly all cheese. Cultures taken from forty-nine samples of American cheese were lethal for white rats, guinea pigs, and rabbits. Members of the colon group were frequently isolated. It is not surprising, therefore, that occasionally some of these deleterious microorganisms may develop to excess during the ripening and storage of the cheese, and confer upon it poisonous properties. Vaughan's work has been repeatedly confirmed by others, notably, Wallace, Wolff, Wesener, and Rossmann. Dokkum, also, using a modification of Vaughan's method, obtained a somewhat different body from poisonous cheese which he termed tyrotoxin. The organism which elaborates tyrotoxin is not known.

The symptoms due to cheese poisoning are, in the main, those of a gastroenteritis. After a preliminary period of from five to six hours vertigo, nausea, and a burning sensation in the esophagus and stomach set in, followed by vomiting, colicky pains, and diarrhea; chilly sensations, occasionally actual rigors, are complained of, and the extremities are cold and clammy. Marked feebleness of the heart's action is present and a sense of intense prostration. In the severer cases there may be delirium and coma. While the colon toxins are more depressing than tyrotoxin, fatal cases are very rare.

Treatment should be active. The stomach should be evacuated promptly by means of a stimulating emetic or the stomach tube. After this, purgatives should be employed, and as soon as the bowels have acted a high rectal enema with a hot saline solution should be administered. Stimulants, such as strychnin and caffein, should be used freely, and heat should be applied to the body generally, but especially to the extremities. Pain should be relieved by hot applications and the cautious use of opium, care being taken not to interfere with elimination.

Poisoning by Food of Vegetable Origin.—POISONING BY MEMBERS OF THE MUSHROOM FAMILY.—*Mycetismus*.—Mushrooms which are essentially poisonous may be eaten in mistake for other species which are both harmless and very nutritious. In some instances a few poisonous fungi have been accidentally included among others which were quite edible. Edible mushrooms may be rendered harmful or even poisonous as the result of putrefactive changes, or by virtue of other parasitic fungi, notably the *mycogona alba*, producing changes in them.

Of the mushrooms and toadstools which form the order *Agaricales*,

there are said to be about one thousand varieties in the United States; one hundred and fifty of these are known to be edible; fifty are of questionable character; and ten are definitely poisonous. Little reliance can be placed on the popular methods of distinguishing harmless from poisonous mushrooms. It is important to note the appearance and position of both volva and veil. Highly colored varieties, and especially those which have an unpleasant smell, and which grow upon decayed vegetation and about the roots of trees, are to be looked upon with suspicion. The color of the spores is, however, of more importance than the color of the gills, for, while the color of the former is constant, the color of the latter varies during growth. The white spores of the poisonous varieties form a strong contrast to the colored spores of the edible varieties. Two specimens are particularly poisonous, the *amanita muscaria*, or fly-agaric, and *amanita phalloides*, or poison cup. *Amanita muscaria* has a pileus varying in color from a yellowish white to a yellowish orange. The stem, lamellæ, and veil are white. The volva appears at the bottom of the bulbous stem, most of it being carried up in the form of loose delicate scales at the top of the pileus. A poisonous alkaloid, named muscarin, has been obtained from the fly-agaric. It is closely allied to neurin and cholin and is a powerful nerve depressant, but it is now generally believed that other toxic principles besides muscarin are in part responsible for the symptoms produced. Of these the most important is fungus-atropin, which has an action resembling that of atropin, and, therefore, antagonistic to muscarin.

The symptoms of poisoning by the fly-agaric develop quickly, within half an hour or an hour. The toxic principle acts as a marked gastrointestinal irritant, producing salivation, vomiting, severe abdominal pain, and diarrhea. Later on cerebral excitement develops, with visual hallucinations, and rarely epileptiform convulsions. This excitement is followed by symptoms of depression; drowsiness sets in; the pulse becomes slow and feeble; the respirations slow and stertorous; the extremities cold; and death threatens from cardiac paralysis.

Atropin is the physiological antidote to muscarin, and gr. 1-100 should be given promptly by hypodermic injection. However, the symptoms in different cases vary considerably, and when the secretions are suppressed, indicating the presence of fungus-atropin, Von Jaksch cautions against the use of atropin. The stomach and bowels should be quickly emptied. Muscarin is soluble in water, so that it is better to produce emesis by means of apomorphin. Afterwards a full dose of castor oil should be given; saline cathartics are to be avoided. As an antidote, tannin, grs. x-xv, in weak solution, may be given by the mouth every fifteen minutes until four or five doses have been given. The dose of atropin may be repeated with caution in one or two hours if symptoms appear to require it. The heart's action must be maintained by cardiac stimulants, rest in bed, and hot applications to the extremities. A small dose of mor-

phin may be given to relieve the pain. As the toxin is rapidly eliminated, time is an object and the measures adopted should be prompt and vigorous. Every effort should be made to tide the patient over the crisis by careful stimulation.

The *amanita phalloides* is the most poisonous of the mushroom family; its toxic principle is extremely powerful, and at present there is no positive antidote for it. The plant, superficially, resembles some of the edible species; its color varies. The pileus may be white, yellowish, greenish olive, or brown; the stem, lamellæ, and veil are all white. The pileus is often viscid and slimy, and when old is devoid of any remains of the volva. The volva presents considerable variations, sometimes being carried up to the top of the pileus, at other times remaining as a cup at the base.

The active principle is a toxalbumin, named by Kobert phallin, which is capable experimentally of exerting a marked hemolytic action. Amanitotoxin, separated by Ford, has very similar properties and is probably identical.

Poisoning by *amanita phalloides* is not at all uncommon in Germany, though less frequent on this side of the water. It is much more serious than poisoning by the fly-agaric mushroom, 75 per cent. of the cases proving fatal. Phallin is distinctly more irritant to the gastrointestinal tract than muscarin, and severe cases of poisoning by it remind one somewhat of the algid state of Asiatic cholera. In poisoning by phallin symptoms develop in from nine to fourteen hours; we meet with vomiting, abdominal pain, and excessive diarrhea. The hemolytic nature of the poison is shown by the occurrence of blood-stained serous stools, jaundice, and hemoglobinuria. Death occurs in from four to five days.

An effort should be made to secure prompt evacuation of both stomach and bowels on the lines indicated for muscarin poisoning. Atropin has power over only a few of the symptoms, but in some cases may be tried in doses not exceeding 1-100th of a grain. Injections of normal saline solution into the rectum or subcutaneously should be given to assist elimination. Rest in bed and warmth to the extremities and to the trunk are demanded; strychnin, caffein, and camphor may be given hypodermically. Ford has succeeded in preparing an antitoxic serum from rabbits, 1 c. c. of which will neutralize a fatal dose of an extract of the *phalloides*. It remains to be seen whether it is possible to prepare a serum that can be used successfully in man.

Besides the toadstools and mushrooms there are a great many varieties of the higher plants that possess poisonous properties. Many of these are well known and have made their way into the pharmacopeias; not a few are widely spread in nature, and are distinctly dangerous to life when unwittingly eaten by children and by those ignorant of their effects, or

when cut down and included in the fodder of cattle. Some, again, have been used for food during periods of stress and famine.

POISONOUS ROOTS.—Many roots are distinctly poisonous, owing to the presence in them of various toxic principles, of which the most important is the glucosid *saponin*; only a few, however, are of sufficient importance to demand mention in this article.

The common *potato* has been known at times to cause poisoning. This is perhaps not to be wondered at, when we remember that the family to which it belongs, the *solanaceæ*, contains also such members as *belladonna*, *henbane*, and *stramonium*. The poisonous element, *solanin*, situated chiefly beneath the skin, is present in all potatoes in small amount, but is more abundant in young potatoes and in young shoots. It appears to be formed in larger quantities in those potatoes that are partially green owing to their becoming uncovered in the rows, a condition likely to happen after a rainy season; it also exists in considerable quantity in old potatoes kept in damp cellars, especially if they are sprouting. Cases of poisoning have occasionally occurred when, owing to a scarcity of provisions, old potatoes with the sprouts attached have been cooked and eaten. The poison is especially abundant in the rhizomes near their attachment to the tubers. The deep purple shoots contain the most and the percentage lessens as the shoots become white and green. Potatoes affected by black fungus are also said to contain much *solanin*.

Symptoms come on from two to twelve hours after ingestion of the potatoes, with chilly feelings, severe headache, mental depression, and some gastrointestinal irritation. There is moderate pyrexia; jaundice occasionally occurs. In six hundred cases reported no death resulted.

The treatment consists in evacuation of the stomach and bowels, and meeting other indications as they arise:

Pokeroot (*Phytolaccæ decandra*) is occasionally eaten in mistake for horseradish, which it somewhat closely resembles. In large doses it causes vomiting and purging, followed by convulsions and coma. The toxic principle is believed to be *saponin*.

Cicuta roots (*cicuta maculata*, *water hemlock*), which are crisp and juicy, and have a somewhat pleasant aromatic taste, have at times been mistaken for artichokes and used as a food. The toxins are *cicutoxin* and probably *coniin*. The symptoms produced are not unlike those of hemlock poisoning, but are of a more irritant type.

The *euphorbiaceæ* are frequently poisonous. One of the most important species in this family is the *cassava* root, from which tapioca is made. There are two varieties: the bitter and the sweet cassava root, both of them largely cultivated in tropical America, where they form one of the most important of the food products. The sweet variety is a staple article of food occupying the place of the potato with us. Grated, dried, and ground into flour it furnishes a breadstuff scarcely second in importance to wheat

flour. The bitter variety has to be freed from its hydrocyanic acid by a process of fermentation. Unfermented, the roots are highly poisonous, containing on an average .0275 per cent. of prussic acid, so that, when eaten either through ignorance or by mistake, fatal symptoms develop promptly. They are said to be a frequent cause of death in Brazil.

Certain species of *yams*, found in the West Indies, have also to be treated by thorough washing before they are fit for use.

POISONOUS FRUITS AND SEEDS.—Chief among these may be mentioned belladonna, bittersweet, potato berries, thorn apple, yewberries, pokeberries, castor oil beans, coral beans, horsechestnuts, darnel, cockle, and certain peas and beans. Few of these need a detailed description here. The darnel, cockle, and certain of the leguminosæ have a certain importance, since they may contaminate grain and fodder.

The *darnel* (*lolium temulentum*) is a grass of Asiatic origin. The fruit, which resembles in appearance a grain of wheat or rye, contains a toxic alkaloidal principle, *temulin*, which may be classified as a narcotic of the delirifacient type. The poisonous effects are seen in gastrointestinal irritation, nausea, giddiness, headache, and drowsiness. Flour may be contaminated with darnel, but rarely contains a sufficient amount to be dangerous; a few fatal cases have been reported.

The *corn cockle* (*agrostemma githago*) may also contaminate flour. Its poisonous properties appear to be due to saponin.

The leaves and stalks of many species of the genus *lupinus* (wild bean, or blue bean) are used in Europe and America, either green or dried, as food for cattle. As a rule, this mixture is wholesome and nutritious. In exceptional cases fatal poisoning has resulted, which appears to have been due to the presence of ripe seeds in too great abundance. The toxin in these seeds resembles digitalis in its action on the heart, but it is also an active delirifacient and an irritating diuretic.

The common *horsechestnut* (*æsculus hippocastanum*) contains saponin-like bodies which are toxic in character. A flour made from this nut deprived of its harmful properties is made in Germany and is highly nutritious, but any lack of care in its preparation may lead to the development of toxic symptoms. A variety of chestnut, the *buckeye* (*æsculus pavia*), is much more dangerous, and fatal poisoning by it has occurred.

POISONING BY HERBAGE.—A great many herbs are poisonous through their leaves and stems. Many of them are to be regarded purely as drugs, and, as such, have gained admittance into the pharmacopeia. It is very seldom in this country that they are to be found acting as food poisons. Some few of the common herbs may be harmful to certain individuals, even when regarded by the ordinary person as innocuous. Others, which are excessively poisonous, may be gathered in mistake for edible herbs.

Watercress (*nasturtium officinale*), though commonly regarded as a harmless delicacy, in large amounts may give rise to cystitis.

The various forms of *larkspur* (*fam. ranunculaceæ*) and loco weeds (*fam. leguminosæ*) are dreaded by farmers and stock breeders as very poisonous to cattle. The former contains a poison resembling aconite in its action.

The *rhododendron* is also poisonous. A historic instance of poisoning by the active principle of this plant is recorded by Xenophon in his *Anabasis*. Many of his soldiers, when passing through Trebizonde, ate the honey extracted by bees chiefly from this plant, which grew in great abundance in the region, and promptly developed toxic symptoms of vomiting, diarrhea, and stupor. No deaths occurred.

Poisoning Due to Fungi.—Under the term *sitotoxismus* Vaughan includes all forms of poisoning by cereal foods due to the presence of fungi or bacteria. The best-known examples of this class are ergotism, maidism or pellagra, and lathyrism.

ERGOTISM.—Ergotism has been met with both in the acute and chronic form, and is due to the use of bread made from rye contaminated with a fungus (*claviceps purpurea*). In former times numerous epidemics of this disease made their appearance in the various countries of Europe. The symptoms were especially disastrous among the poorly-nourished and badly housed, and developed with special intensity after damp seasons, and from infected rye grown in marshy districts and in the shade. Examples of ergotism are now very rare.

Acute ergotism may occur when bread containing as much as 2 per cent. of the active principles is eaten in quantity. Children and pregnant women are the most readily affected. The symptoms develop in from five to six days; vomiting and diarrhea are marked features. Death may take place from cardiac paralysis.

The treatment consists in the withdrawal of the poisonous bread and the substitution of a nutritious diet, especially meat, eggs, and fresh milk. After effective purgation, intestinal sedatives containing tannin should be administered. The cardiac weakness demands the use of effective tonics. Nitrites may be of service to relieve vascular pain. Any gangrene present should be treated on general surgical principles.

PELLAGRA will be treated in the following chapter, to which the reader is referred.

LATHYRISM.—Lathyrism, or poisoning by the chickpea or vetch (*lathyrus sativus* or *L. cicera*), is a milder disease than either ergotism or pellagra. It is never met with in this country, but is occasionally seen in India and northern Africa. It is attributed to a toxic principle existing in the seeds of pulse which have been used to adulterate flour. When the husks of the seeds are incorporated with the meal its toxic properties are increased. The disease is a very ancient one, having been known to Hippocrates. Extensive epidemics of it occurred in Würtemberg during the seventeenth and eighteenth centuries.

Treatment consists in the obvious measures of prophylaxis. As many cases occur in times of famine, proper food must be provided. All measures suitable in the treatment of spastic paraplegia should be carried out. In general, we can only relieve symptoms. The constant or alternating current may be of value, but must be used for prolonged periods. Baths from 86° to 90° F., two or three times weekly for ten to fifteen minutes, may be of service in relieving spasm.

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CHAPTER V

PELLAGRA

EDWARD JENNER WOOD

Little progress can be made in the treatment of pellagra until more is known of its etiology. There have always been opponents to the theory that diseased or damaged corn causes the malady. Various explanations have been given accounting for the noxiousness of the corn, but all have lacked that finality necessary for general acceptance. At this time the students of pellagra are divided into the zeists, or advocates of the corn idea, and the antizeists, or those opposed to it.

PROPHYLAXIS

Prophylaxis is all-important, as there is no specific; and yet this must remain in a very unsatisfactory state until the question of etiology is settled.

Until 1907 pellagra held only scientific interest for the American physician, but since that time it has been recognized in thirty states; and in the southern states has become a problem second only to tuberculosis in importance.

Corn was first connected with pellagra by the work of Marzari (11) in 1810. The most important work along this line was that of Lombroso (10), who devoted twenty-five years of his life to it, and who, just prior to his death, expressed satisfaction at having reduced the disease in Italy. As a result of this work the attention of the Italian government was directed to the inspection of corn. It was demonstrated that the imperfect covering of the embryo, together with the large amount of fat contained in the kernel, favored deterioration and rendered corn more perishable than any of the other food grains. Lombroso concluded that the disease was an intoxication resulting from the products of the life processes of certain molds, which in themselves were not harmful. He emphasized the part played by moisture, and thought that transportation, especially by water, was the cause of a great part of the deterioration.

Acting on Lombroso's suggestions the Italian government undertook the drying of corn by various artificial means. The people were taught to leave the corn on the stalk until mature, and to thoroughly dry it before storing. It is claimed by some authorities that the improvement in corn culture and more careful storing have wiped out pellagra from certain sections of Italy. On the other hand, recent reports are not altogether confirmatory of this opinion.

Ceni (5) taught that the *Aspergillus fumigatus* and the *Aspergillus flavescens* were the direct cause, and that both of these molds were found in diseased corn. Tizzoni (14) attributed it to a specific microorganism which he isolated from the blood, the feces, cerebrospinal fluid, and organs at autopsy. There is not sufficient evidence from these experiments to establish the claim. In spite of the fact that, in the hands of such competent observers as Lombroso, Tizzoni, Cuboni, Ceni, and many others, certain changes were produced in the lower animals, as the falling out of feathers in fowl and of hair in rabbits, still the fact remains that we are ignorant about the appearance of pellagra experimentally produced. It has never been proven that the disease can be experimentally produced. The recent work of Anderson (1) and Lavinder (8) in their attempts to reproduce the disease in monkeys by direct inoculation of the blood of a pellagrin was not conclusive.

It is indeed difficult to find an explanation for the appearance generally throughout the southern states in 1905 of a disease hitherto unknown in that section. Certainly at that time there was no reason to attach the cause to the corn, as this particular crop has been materially improved during the last decade. Corn from the western states has been largely used in the southern states for many years, and there is no evidence to show that western corn has recently deteriorated. If the corn has been the cause it seems most reasonable to suspect that the trouble occurred in the process of transportation. Interest in this question has led to a much more rigid inspection of corn, with the result that it has been discovered repeatedly that corn for sale on the market in the southern states was unfit for food. Recently a large consignment was condemned by government officials in South Carolina. This one fact, that corn unfit for food has been found on the market, is sufficient ground for a more rigid government inspection, regardless of the consideration of pellagra. Certainly, until the question is finally settled, it is the duty of the physician, especially in pellagrous districts, to warn the people against the use of bad corn, and in all cases of the disease to absolutely exclude corn from the dietary.

In 1905 Sambon presented his hypothesis that pellagra was a protozoal disease, and that it was transmitted by an intermediate host which he thought to be the *Simulium reptans* or buffalo gnat. Subsequent investigation in Italy served to strengthen this view, and a recent report

claims that this fly is invariably found wherever the disease occurred. Sambon further claimed that on a pathologic basis pellagra has no right to be classified with diseases due to grain poisoning, as ergotism, but that the presence of round-cell perivascular infiltration and increase of the mononuclear elements of the blood placed it in the group of diseases of animal parasitic origin with trypanosomiasis and kala-azar. It was further claimed that the insect in question only deposited its eggs in aerated water as in the rapidly flowing stream above tide water, and that the placing of eggs in stagnant water resulted in destruction in a few hours. It is a noteworthy fact that pellagra only occurs sporadically in the counties of North Carolina bordering on the Atlantic Ocean, and that the points of greatest prevalence are in the Piedmont section, where the streams answer the requirements of the *Simulium*. It remains to be proven if this view of Sambon accounts for this geographical peculiarity. Until more is known on this subject it is not justifiable to begin war on the buffalo fly.

TREATMENT

Many drugs have been used in the treatment of pellagra, and many mistaken claims have been made. For example, thyroid extract was thought by one competent observer to produce good results. It must be borne in mind that it is a disease of seasonal variations, and that it is the rule for improvement to occur at certain seasons regardless of treatment. The only drug which has stood the test is arsenic. From Coletti and Perugini its use was revived by Lombroso and given new impetus. Lombroso thought that sodium chlorid was equally beneficial, but hard on the gastric digestion. As a result of this opinion measures were adopted in Italy for the free distribution of salt among the peasantry.

Recently, as the idea has grown that pellagra is a disease of animal parasitic origin more nearly akin to trypanosomiasis than to ergotism, the treatment of the former has been largely imitated. Babes (2) in Roumania was the first to use atoxyl, and it at once became very popular. Babes, Veseliu, and Gheorghus (3) treated a series of cases by the combined use of arsenic trioxid and atoxyl. Simultaneously they gave hypodermically 0.5 gram ($7\frac{1}{2}$ grains) of atoxyl, an inunction of 5.0 grams (75 grains) of a one to fifty preparation of arsenic trioxid in lanolin, and 0.0013 gram (1-50 grain) of arsenic by mouth three times a day. This treatment was repeated at varying intervals, depending on the severity of the attack. The results were very satisfactory.

The writer recalls a case so treated. The patient was a white man aged 50 years, a common laborer. Though it was classified as a hopeless case at the time of treatment, two years have elapsed without a recurrence, even though there was no improvement in the general hygienic conditions, nor did the man cease the use of a poor quality of corn, though so advised.

It is not usual that such active treatment is necessary. From 0.33 to 0.50 gram (5 to 7½ grains) of atoxyl given every fourth day, gradually lengthening the interval between doses, is usually sufficient. Atoxyl must be given in cold sterile water, as it decomposes upon heating. This necessitates great care in technique. The drug should never be administered by mouth, as it is decomposed by the acid gastric juice. Optic nerve atrophy has been reported from the use of atoxyl, and care should therefore be taken to have the eyes watched by an oculist during this treatment. It has never occurred in the writer's experience with its use in a large number of cases actively treated. The presence of albumin is always a contraindication to the use of atoxyl. The writer has seen symptoms of acute arsenical poisoning occur from the use of atoxyl, but is inclined to think this was due to the preparation of the hypodermic with hot water, thereby causing the decomposition of the drug.

The results obtained by the writer in the treatment of pellagra with atoxyl have been very gratifying. When first used, results not being immediately forthcoming, little faith was had in it; but it was soon found that patients discharged from the hospital unimproved and sent home in the ambulance would oftentimes make such permanent improvement as to be able to resume their several labors. The subsequent history shows that this improvement was not temporary, since in many instances two or three years have elapsed without recurrence.

The writer has observed that, in those cases treated with atoxyl, it is not uncommon, on the first and even on the second anniversary of the original outbreak of the skin manifestations, to see a recurrence of the symmetrical erythema unaccompanied by any other manifestation of the disease. This occurrence is of no consequence, and does not indicate a cessation of the general improvement. It is not wise to count a case cured until three seasons have elapsed without recurrence.

Atoxyl is of no benefit in the fulminating type of the disease; but, fortunately, the number of such cases in the southern states is rapidly decreasing. When pellagra was first recognized in this country such cases were more the rule than the exception. The first authentic report of a number of cases was made by Searcy of Alabama (12), and all of these were of the fulminating type, with a few exceptions. So far no remedy has been brought forward for the treatment of these cases which has accomplished anything. The condition is counted absolutely hopeless.

Soamin, which is an arsenilate of sodium, is very similar to atoxyl, except that it contains 22% of arsenic, while the latter contains 26%. Soamin has been used extensively by Babcock in South Carolina with encouraging results.

Sodium cacodylate has also been given with good effect, though its use has not been so general as that of the other drugs above mentioned. The same dosage is employed as in syphilis.

Salvarsan has been used with excellent result by Caryophyllis and Sotiriades (4) in the treatment of kala-azar. The result was a decided

improvement in the temperature, reduction in the size of the spleen, decrease of sweats, and improvement in the blood picture. Such results suggest its further use in pellagra.

The writer has used salvarsan in the treatment of this disease, but the results so far have not been encouraging. It seems not improbable that the better results obtained from the use of atoxyl were due to the fact that it was repeated at shorter intervals and continued for a much longer time, and that the patient did not get the same prolonged arsenic effect from the fewer doses of salvarsan.

Arsacetin has been employed by Ehrlich as a substitute for atoxyl and soamin. It is the acetyl of atoxyl, and is sold in the form of the salt. The writer has had no experience with its use.

Fowler's solution and Donovan's solution have both been employed, and there can be no doubt of their efficacy in mild cases where an immediate arsenic impression is not necessary. In severe cases their usefulness is more limited because of the time consumed in reaching a sufficiently large dose to be of any avail.

As a rule pellagra in children is a mild disease, and in many cases nothing more is needed than an improvement in the general hygienic conditions. In the cases severe enough to require medication Fowler's solution is indicated.

Diet in pellagra is of great importance, and is one of the most difficult parts of the treatment. When the stomatitis is violent, as is so commonly the case, the patient will refuse all food. In those cases with gastric disturbances, especially when vomiting occurs, mouth feeding is difficult; and the diarrhea which usually accompanies any of the other digestive disturbances makes rectal feeding impossible. In those cases with intractable diarrhea it is exceedingly difficult to find any form of nourishment that can be borne. In all cases milk should be given if possible. If large curds are found in the stools after the taking of milk, peptonization should be tried. After the plain or peptonized milk has been well borne for several days it is advisable to add a raw egg to each milk feeding, thoroughly beating the two together. In some cases buttermilk is more acceptable and may be given freely. A mixed broth composed of a cereal, as rice or barley, and a meat, as beef, mutton, or chicken, will be of service. It is best, in employing such a broth, to make the cereal and the meat broths separately and combine them in such proportion for each feeding as the occasion may require. An absolute liquid diet should only be depended on for a short time; and for it should be substituted a diet composed of milk toast, cereals and cream, and soft-boiled eggs. Later rare beef, dry toast, and potatoes may be added. Fruit and vegetables should be withheld until convalescence is well established.

To meet various symptoms a multitude of drugs has been tried. For

the stomatitis all astringents have been tried and found of no effect. The newer silver preparations, as argyrol and protargol, are thought by some to be of benefit.

In the writer's experience cleanliness of the mouth does as much good as any of the drugs suggested.

Again, for the diarrhea, all the astringents, especially bismuth and tannic acid, have been tried, but ineffectually.

Following a suggestion of Tennenbaum (13) the writer has used almateina, hoping that it would check the diarrhea. This drug is a synthetic product claimed by the chemist Lepetit to be produced by the action of formaldehyd on hematoxylon. It occurs as a fine powder of a dark red color. It is given in capsule in the dose of 0.5 gram ($7\frac{1}{2}$ grains). It has not been in use in pellagra long enough to test it thoroughly. Some favorable results have been obtained from its use.

Hydrotherapy has been advocated by many writers on the treatment of pellagra. All forms of baths have been tried. Such treatment should only be given by an expert, as otherwise it is calculated to do much harm, owing to the debility of the patient. Cold baths especially should be used with discretion. Medicated baths, chiefly of sulphur and arsenic, have been tried. The special indication for this form of treatment is in certain skin conditions and also in intestinal disorders, especially when accompanied by marked wasting. The salt rub is also favored by some, and is particularly advised in the treatment of children.

Radical changes of scene and climate are often of the greatest benefit. It is no uncommon thing for severe cases to improve greatly, if not entirely recover, following this change, and without other treatment.

The establishment of institutions for the treatment of pellagra must come with time just as they have come in Italy. It is to be hoped that the time is not far distant. Certainly nothing can do for these poor unfortunates what an institution will do. At this time much of the overcrowding in southern insane hospitals could be relieved by separate institutions for the pellagrous insane.

Finally, the most important feature of the whole subject is rest. It is no less important than in tuberculosis, and it is here that institution treatment is so helpful. As long as there is any intestinal disturbance rest is imperative. It must be remembered that hemorrhage may occur in pellagra from an intestinal lesion. Dr. J. K. Hall had under his care at the North Carolina Hospital for the Insane a pellagrin who died from such a hemorrhage. Besides a consideration of the intestinal condition there are many nervous manifestations benefited by rest in bed, and in many of the cachectic pellagrins it is imperative.

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CHAPTER VI

INTESTINAL AUTOINTOXICATION

(*Autoinfection*)

HOWARD S. ANDERS

“Man comes into the world with his intestines free from all germ life.”

“Harmful microbes may be displaced by those that have been proved beneficial.”—METCHNIKOFF.

Time was—and that not remote—when the term intoxication meant almost exclusively the perverted and excessive use of alcohol. Within a decade or two chemical physiology and clinical and experimental pathology have marshaled such an array of endogenous poisons and resultant abnormal processes and products, as to make the comparatively recent word autointoxication embrace quite a host of gastrointestinal and metabolic ailments, and well-nigh overshadow the prevalence and importance of alcoholism.

It is very evident that the problems of food, dietetics, habits of eating and eliminating waste in the body command immensely more scientific and practical investigation and application than formerly; also relatively as bearing upon the ingestion of alcohol—and properly so. It matters that the hygienic and therapeutic care and treatment of the eater be as regular, constant, and diurnal as the ocean tides; it occurs with the drinker as incidental, periodic, and occasional as the squalls and storms of the North Atlantic.

In this article the treatment of intoxications arising from the alimentary canal has to do either with endogenous parasitic (bacterial) processes; or with metabolic perversions due to retention products of fecal accumulation. It must be admitted, however, that gastrointestinal infections of exogenous origin do, as A. E. Taylor points out, “entrain real autointoxications by disturbing the natural progression of metabolism.” Furthermore, gastrointestinal autointoxication must, of course, be distinguished from ptomain poisoning (an exogenous intoxication) as well as from the gastrointestinal infections; although many cases arise where the clinical pictures make the differential diagnosis very difficult.

Autointoxication certainly is a more frequent condition than has usually been credited. It is a concomitant of many, if not most, all digestive disturbances, particularly those of retention from impaired motility. It may arise from internal decompositions of animal food and from bacterial activity in the intestines. The failure of the body to eliminate waste is a foundational cause for many of the disturbances of health which may be embraced under the term autointoxication of intestinal origin.

Abundant, accurate, and ramified investigations are necessary as to the morbid consequences of intestinal putrefaction; the action of toxins upon the intestinal tube itself; and particularly their rôle in the development of acute and chronic disorders, and, perhaps, diseases recognized as distinct clinical entities.

We have yet to learn a great deal concerning the actual toxic substances giving rise to certain symptoms or clinical pictures of autointoxication: The composition and properties of these substances; the protoplasmic and systemic reactions to them; "the velocity of toxic action; the nature of toleration and immunity; the interreaction of poisons upon the chemical reactions of metabolism; and the relations of solubility, coefficient of distribution, ionization, and velocity of diffusion to toxic action" (A. E. Taylor).

Until the chemistry of physiology and pathology determines what the precise causes of intestinal autointoxication are the clinician cannot with accuracy or much probability diagnose the specific variety of a malady; nor, perforce, treat the autointoxicated patient with the desirable assurance of speedy and substantial results. It is a remarkable and hopeful sign, however, that a broad and profound recognition is being made of the importance of physiologic and pathologic chemistry in the direction of discovering the essential origins of certain affections and complications of difficult and doubtful diagnosis; and whose treatment must meanwhile necessarily be merely general, symptomatic, and to some extent unreliable. Nevertheless, sufficient knowledge has already been attained to justify a somewhat categorical presentation of the subject of treatment, based upon the nature of the causes, their origins, selective affinities of location, and pathogenesis or modes of action. The therapeutics of intestinal autointoxication, therefore, while not specific on the one hand, is not blindly empiric on the other, but may be said to follow a safe middle course of the progressively and tentatively scientific.

At all times, the earlier and more thoroughly the definite or probable causes of the autotoxemic symptom-complex can be differentiated and eliminated, and their direct and threatening deleteriousness and tendencies antagonized and halted, the better. The insidious damaging effects of certain poisons upon subsequent vitality and vigor have not been determined fully, but their evidence, nevertheless, is undoubted and often subtly prolonged, as in the case of the analogous sequelæ of influenza. As intimated

before, however, too little is known of the chemical nature of the intestinal poisons generated and their specific symptomatology to base treatment upon an etiologic or chemic classification of causes. A pathogenetic basis of therapeutics is more to the point, since we do know somewhat the course of development of poisons in the intestines; the conditions giving rise to them and aggravating them; and the pathologic and clinical results of their resorption, as from putrefactive and fermentative processes.

In the present state of our knowledge the most satisfactory, practical, and beneficial lines of treatment are based in general upon such symptoms as present most frequently and predominantly. Thus, the various systems of the body have their more or less characteristic reactions to the resorption of toxins of enterogenous origin. Also, certain well-defined diseases or clinical entities undoubtedly originate, or are in great part produced or continued by intestinal autotoxins, such as tetany, migraine, urticaria, perhaps exophthalmic goiter, etc.

Overeating, rapid eating, excessive eating of foods ill-adapted to individual digestive functions; adulterated foods; rushing to physical and mental labor immediately after meals instead of allowing the process of digestion a normal start of vigor by resting body and brain for a half hour or so; at times the too heavy American breakfast or luncheon—all or any of these and some other habits are more or less contributory or essential in the development of gastrointestinal autointoxication. The prophylaxis is obvious. It requires that patients be seen and studied at intervals; taught to regularity and discipline of habits; and guided for a sufficient length of time as to details in food selection and arrangement of combinations, until the personal equation be satisfied unto health, normal weight, and energy, endurance and reserve power. The hygienic and therapeutic method of diagnosis in suspected cases of gastrointestinal autointoxication usually leads to a clear differentiation.

Inasmuch as intestinal autointoxication is the result of the development of toxic bodies from abnormal digestion, and of toxins produced within the intestines by the abnormal action of bacteria, a brief reference may be made to those elements which may or may not influence one's judgment in attempting specific treatment.

Digestive Juices and Secretions.—Clinically there are at present no symptomatic or objective evidences of gastrointestinal autointoxication which point to resorption of the digestive fluids, secretions, or ferments: their toxicity, even should a resorption occur, is questionable and certainly not a fact of clinical observation.

Normal Products of Digestion.—There is no proof that symptoms of gastrointestinal autointoxication are due to peptones, amido-acids, albumoses, or the products of fat and carbohydrate digestion.

Abnormal Products of Digestion.—In connection with the digestion of fats gastrointestinal symptoms of so-called acidosis may be recognized, due

to the abnormal formation of β -oxybutyric and diacetic acids, with acetoneuria. It is not improbable that oxaluria is occasionally an evidence of gastrointestinal disturbance due to abnormal digestion of carbohydrates.

Normal Products of Bacterial Disintegration of Food.—There is no clinical evidence that the normal bacterial disintegration of normal food-stuffs produces intoxications within the intestinal tube; or that the products of such disintegration are toxic, even when formed temporarily in excess, then causing merely a local irritation or inflammation. Normally a certain amount of digestive fermentations and putrefactions are constantly in operation, the fermentations predominating. None of the acid products of normal carbohydrate fermentation, excepting oxalic acid, are toxic; and none occur in any but very small quantities (traces) in the feces, being either absorbed or neutralized and oxidized. The benzol derivatives of the normal putrefaction of protein—indol, skatol, phenol, and cresol—are all practically innocuous in the quantities yielded. The amido-acids, sulphurous substances, and hydrocarbon gases are also without toxic effects as the result of normal bacterial disintegration of food. Doubtless, with the normal bacteria regularly carried into the stomach with the food numerous others with more or less pathogenic tendencies are associated. But in normal digestion most of the latter become destroyed or very much reduced in virulence by the hydrochloric acid in the stomach.

On the other hand, intestinal toxic symptoms may develop from excessive bacterial operation upon more or less large masses of food, with irritation (enterocolitis) from the acidosis. Nor is it rare to meet with hydrogen sulphid eructations and borborygmi, with expulsion of large volumes of offensive gas from the rectum, nausea, and depression due to excessive putrefaction of eggs and egg-containing pastries. Paroxysmal attacks of epigastric pain, pressure, heartburn, and colicky flatulence may be due to excessive quantities of lactic acid fermentation of such carbohydrate foods as griddle cakes, hot bread and biscuits, and the like. Indeed, in the small intestine, fermentation, whether the result of faulty digestive chemistry or of obstruction, is much more common than putrefaction. It is thus rarely necessary to treat intestinal discomfort of short duration on the basis of toxicity, even should a brief high indicanuria or excess of conjugated sulphates be noted, especially if diarrhea be associated, which soon eliminates the putrefactive elements. With the body in a physiologic condition the organs of defense are ordinarily capable of protecting the organism against autointoxication.

Abnormal Products of Bacterial Disintegration of Food.—Ptomaines are not in this class, being introduced from without by eating decomposed food. Symptoms of intestinal intoxication suggestive of ptomain poisoning may, by later investigation, however, be found to be due to certain isolated ptomaines of toxic effect where decomposition has really begun within the bowel. Thus it is clinically evident that some persons suffer

invariably from symptoms of autointoxication after eating a certain kind of sausage, which to others is innocuous, and which is free from all taint of ptomaines in recognizable amounts. It is quite probable, in view of such manifestations, therefore, that whether the symptoms of intestinal auto-intoxication be due to ptomaines in obscure but virulent amounts generated within the bowel, or to leukomains in the tissue of an apparently healthy meat food, or some other substances of faulty intestinal digestion, we have to consider individual susceptibility, idiosyncrasy, or as yet unspecified cellular chemistry of resistance. The fact is that some persons are naturally, or, so far as the average human is concerned, abnormally sensitive to particular poisons produced within the intestinal tube, usually associated with the ingestion of particular articles of food. So long as the epithelium remains intact and healthy the body is fairly well protected from invasion by the bacteria which happen to be present in the intestine. Intestinal indigestion is not infrequent in some individuals who eat certain articles of food; and it is quite possible that these articles allow the bacteria normally present in the intestines to multiply with abnormal rapidity, or that they reduce the resistance which the flora of the intestines normally exerts against foreign invaders. Again, the abnormal bacterial growth may follow changes in the secretory or motor functions of the intestines. Normal bowel movements are most important means in limiting abnormal bacterial growth; constipation being the one predominant factor in the production of autointoxication in myriad forms. Of the poisonous products sometimes elaborated by intestinal bacteria a portion may be absorbed and symptoms of autointoxication ensue because of elimination being prevented by intestinal or other diseases, particularly affections of the kidneys which seriously interfere with elimination. It is also possible that the nephritis which so frequently follows intestinal obstruction is caused by the products of intestinal decomposition.

TREATMENT

If, as Bouchard has demonstrated, the gastrointestinal tract is the source of the largest number of poisons that cause autointoxication, then clearly this is the part of the body that calls for special attention and treatment. Here, as elsewhere, prevention precedes the attempt to cure. In general, four lines of treatment for intestinal autointoxication may be laid down, namely: prophylactic, dietetic, hydriatic, and medicinal. Prophylaxis includes the avoidance of all food that is capable of undergoing fermentation and putrefaction to an abnormal degree. The next step is to prevent the enterotoxins from penetrating into the system by absorption: this means measures directed to as speedy and thorough elimination as possible through the emunctories. To stimulate the action of the liver, which is a physiologic destroyer of poisons which have been absorbed, is also an important procedure in the treatment of intoxication.

Whatever the variety of intestinal intoxication, in acute cases rapid and almost heroic elimination may be necessary at the outset. In chronic cases, where autointoxication is the underlying and predominant condition, or an aggravating and complicated feature, systematic hygiene, dieting, and constant or intermittent measures of extra elimination are indicated.

In most instances of intestinal autointoxication local symptoms predominate, associated not infrequently with skin manifestations. The symptoms are pain, vomiting, often diarrhea, some fever, followed by a general erythema or urticaria. In such attacks of mild or moderate severity recovery usually follows promptly after gastric lavage, irrigation of the colon, and free purgation.

Should the vomiting be rather sudden, violent, and intractable, with extreme pain, profuse diarrhea, meteorism, local spasms, vertigo, shock, vasomotor dilatation, and even convulsions and coma, the probabilities are that one is dealing with a most virulent form of intestinal putrefaction from the decomposition of albuminous food, provided an exogenous intoxication can be excluded.

An unusual development of gas (meteorism and tympanites), with eructations, epigastric burning sensations, and acid vomiting, usually indicates an abnormal activity of fermentation. There is also a painful diarrhea with greenish-colored stools. Subjectively, depression, headache, fatigue, tinnitus aurium, and vertigo are complained of. The more marked these symptoms, with the concomitant expulsion from the bowel of sulphuretted hydrogen, the more evident the predominance of putridity. A diagnostic test diet should be employed in such cases, wherein proteid foods and extraneous bacteria should be excluded, and sterilized buttermilk administered for a day or two; later, with improvement in the condition of the patient, sweet milk, bread, light puddings, and similar starchy foods may be allowed, and proteids resumed only with the greatest deliberation and caution.

Not only overeating in general, but the excessive use of albuminous food in particular, that is, a preponderating quantity of meat, eggs, cheese, and meat soups, all tend to increase intestinal putrefaction. The application of prophylaxis here is obvious. The drinking of large quantities of water with meals also favors intestinal putrefaction, by retarding digestion by the dilution of the gastric juice. Another factor tending to encourage intestinal autointoxication and, simultaneously, calling for correction, is any functional inactivity of the liver, as evidenced by light-colored stools of more or less pasty consistency, diminished excretion of urea, and the presence in the urine of abnormal constituents.

Anti-putrefactive Diet.—The arrangement of an antiputrid diet is especially needful in cases of chronic putrefactive toxemia. It is of paramount importance that the dietetic requirements should be studiously in-

lividualized. The proteins must be reduced to a reasonable minimum; and, if necessary, albuminous foods should be entirely excluded and farinaceous foods substituted. The lactic acid furnished by the latter inhibits the action of the proteolytic bacilli in the large intestine from acting abnormally on albuminous food substances. It would seem from a long series of physiologic and calorimetric tests that the majority of people, particularly adults in city life, consume much more proteid food than is necessary to maintain health and muscular efficiency. Therefore, the amount of proteid food daily ingested may be reduced considerably without prejudice to the individual in health, and must be reduced very materially in one suffering from intestinal putrefaction. Says Abrams, "The actofarinaceous diet of Combe is the antiputrid régime *par excellence* of intestinal autointoxication. It acts not by any destructive influence on the intestinal flora, but seeks only to modify the soil in which the microbes live." Here, then, milk is, of all foods, the most serviceable. It has been shown that even with a moderate meat diet milk diminishes the production of enterotoxins. The antiputrid properties of milk are due to the lactic acid which results from the decomposition of the lactose which it contains. The milk may be taken raw, pasteurized, or boiled, the latter especially when diarrhea is present; or poured over toast, then strained before administered. Some patients are able to take ordinary curdled milk, or clabber; others do well on buttermilk; whey, zoolak, kefir, and fer-mil-lac. Fresh soft cheese provides a little sustaining proteid nutrition and at the same time provides most of the advantages of milk.

However, the best procedure is, undoubtedly, to be found in combining milk and cereals in the diet. Thus, the various wheat and rice breakfast foods, farina, tapioca, sago, cornstarch, purées, baked potatoes, macaroni, and the like. It is important to cut out cane sugar from the diet so as to avoid fermentation and disturbances of digestion. The various light breads and biscuits, toast, zwieback, Holland rusk and lightly sweetened cake, such as ginger-bread, and simple cookies, are permissible. Finally, to limit the total amount of food to the needs of the body, so as to make the necessary work of the liver and kidneys as light as possible in order that those organs can devote their fullest energies to neutralizing and eliminating the putrefaction toxins to which the tissues are intolerant, is also a requirement of importance.

In individualizing the dietetic requirements for particular patients the general condition, and any special diseases that may be present, must be taken into careful consideration in the adjustment of the antiputrefiable foodstuffs. Particularly if the patient has been in the habit of eating meat freely for many years and happens to be a thin, elderly person, it is not always advisable to absolutely deprive such a person of flesh food, inasmuch as many years of such a diet often makes the individual so accustomed to a large quantity of protein substances that a small amount of meat, eaten sparingly, is no serious contraindication in the treatment of

chronic autotoxemia. Again, in certain young persons, especially those who have not attained full growth, more meat may be allowed relative to the degree of gastrointestinal autointoxication, because the body needs and can assimilate more proteid substances before full development has been reached.

In order to preserve sufficient heat and force for the body, and yet not tax the digestive functions, olive oil, butter, fat bacon, cooked vegetables, preserved or cooked fruit, honey, marmalade, and similar articles should be recommended.

Since Metchnikoff has directed and emphasized attention to the fact that the microbes of sour milk are antagonistic to the microbes of putrefaction, the use of various cultures of the specific lactic acid bacillus, known as the *Bacillus Bulgaricus*, has come much into vogue in the treatment of intestinal putrefaction. There are many varieties of lactic acid bacilli tablets on the market for direct ingestion or for the preparation of a lactic acid milk; but none of these have the efficiency or produce the palatability of milk which is common to the true *Bulgaricus* preparation known as liquid lactobacilline. One small bottle or tube a day of this fluid (half a teaspoonful) is the average dose. The liquid may be taken in milk or water. It is remarkable how soon the stools lose their putrid odor, the tongue becomes cleaner, and the breath sweetened, after a few days' administration of the lactobacilline. The signs of autointoxication disappear slowly, and, therefore, for curative and hygienic purposes it is advisable to continue the use of the lactobacilline more or less continuously for several months. Meanwhile, if the patient's condition improves steadily, easily digestible albuminous foods, like eggs, tender, well-cured ham, chicken, fish and oysters may be permitted, along with green vegetables and fresh fruit.

Of course, to what extent a proteid diet for the apparent needs of the body without intestinal putrefaction can safely be resumed will depend upon the amount of ethereal sulphates found in the urine, as well as the excess of indican and similar derivatives.

Elimination.—*Purgatives* are naturally resorted to at the outset in cases of intestinal autointoxication, but some authorities claim that they often intensify the symptoms. Says Abrams: "They remove the intestinal epithelium and mucus, which practically act as barriers against the absorption of enterotoxins." In weak and delicate individuals, especially in neurasthenic cases, the habitual recourse to drastic cathartics may cause considerable distress, faintness or vertigo and increase of the nervous symptoms. Indeed, it has been the writer's experience in numerous cases of intestinal autointoxication to find a continuance of the symptoms associated with diarrhea. As Strassburger has shown, retarded bowel action rather indicates diminished decomposition products which normally stimulate the intestinal action. So that, it is not unlikely that some

cases of intestinal autointoxication are due to increased peristalsis of the upper bowel. To diminish this hyperactivity of the bowel the fluidextract of coto, in doses of ten to fifteen drops after each meal, has been recommended. If cathartics are used, then the salines alone are indicated, especially the phosphate of sodium or an aperient mineral water. The vegetable cathartics, such as aloes, cascara, podophyllin, colocynth, etc., operate upon the lower portion of the colon mainly, whilst self-poisoning arises, as a rule, in the small intestine.

In very acute cases of toxemia with violent and dangerous symptoms elimination may be necessary by means of venesection, particularly where there is evidence of involvement of the kidneys.

Elimination and neutralization of the gastrointestinal poisons is effected empirically by the age-long use of calomel. It may be given in one large dose of three, five, or ten grains, followed by a saline laxative; or, in cases of moderate severity, in small divided doses at intervals of one-half hour or hour until about one grain has been administered.

Should there be impaction of feces in the colon, sigmoid, or rectum, high enemata of soap and water, with or without glycerin, should be resorted to. In cases of chronic intestinal autotoxemia the weekly, bi-weekly, or, at times, even daily use of colonic flushing by the postural method is to be recommended. In fact, as a health measure for the average individual, who generally eats more than he needs at any rate, and who is often more or less constipated, flushing of the colon once or twice a month is a very beneficial procedure in preserving vigor and vitality and sustaining efficiency and good spirits in one's daily life and work. [Examination of the colon by palpation and percussion not only shows whether the colon is full or empty, but also where the fecal matter is lodged.—Editor.]

Next to be thought of is removal of poisons which have been absorbed in the circulation. To provoke perspiration was the method of antiquity by the use of hot drinks, wrapping in hot sheets or blankets, and the administration of Dover's powder, spirit of Mindererus, and hot lemonade. It is questionable, however, whether the resultant diminution in the quantity of urine does not retard the elimination of toxic products through the kidneys. It is the kidneys chiefly that eliminate toxic substances of gastrointestinal origin, and the drinking of cool water and the application of cool bathing aid elimination by increasing the renal secretions. In some cases it has been found efficacious in relieving the general malaise and depressions accompanying the intoxication, when feasible, to start perspiration with a short bath of from three to eight minutes in an electric light cabinet. This should be followed, however, by brief cold-water rubs or slaps; or a vapor bath may similarly be used. Even with this treatment, where a profuse perspiration has followed uncontrollably, I have known the apparent resultant concentration of toxins in the blood,

owing to deficient renal secretion, to produce severe frontal headaches lasting for four or five hours thereafter. Sometimes autotoxemic patients suffer from marked nervous restlessness and sleeplessness; and in such cases relief is usually obtained by having the patient immersed in a neutral bath for thirty to forty minutes, then given a quick alcohol rub and returned to bed.

Perhaps there is more effective measure in both the relief and cure of chronic intestinal autointoxication associated with atony and dilatation of the colon and the accumulation of enormous quantities of fecal matter than the therapeutic application of the *coloclyster*. By this means it is possible to introduce the largest quantity of water which the colon can hold without overdistinging it. In the ordinary enema it is difficult to introduce more than a pint or two of water, and this is usually taken in a sitting position, so that rarely more than the rectum and lower portion of the sigmoid are reached. When the patient is placed in the knee-chest position or in the Sims' position, the amount of liquid may be increased to four or even five or six pints without causing any inconvenience to the patient. It is the habit of the author to instruct patients to hang the two- or three-quart bag of a fountain syringe about five feet above the floor; then have the patient lie on the left side, without a pillow for the head, on a blanket placed on the floor, with the face turned toward the wall; then introduce the small rectal nozzle and let the water run until a sense of fulness, or even slight discomfort, is felt over the region of the sigmoid and descending colon. The patient is then told to pinch the rubber tube, turn over on the back and (with the head low) let another instalment of water run into the bowel until another sensation of fulness or possibly cramping is felt, and the conducting tube again pinched and held while the patient makes another turn, and this time upon the right side. A third flow of water is then permitted, until the pressure within the bowel can no longer be tolerated; then the flow is stopped. After removal of the nozzle from the rectum the patient is instructed to keep the knees and thighs bent and gently to oscillate the body from right to left and back again several times, at the same time rubbing the abdomen in a circular fashion with one hand. In this way the colon is flushed from rectum to cecum, the flexures are distended, accumulations and old incrustations of dried, sticky fecal matter are loosened and removed with the gushes from the bowel which ensue when the patient arises to solicit relief on the closet. In the knee-chest position the action of gravity is still more helpful in completely filling the colon. This treatment is also beneficial in catarrhal and membranous forms of colitis.

The introduction of very hot water into the colon increases blood pressure, improves and accelerates the heart action, and produces a marked effect upon the renal secretion. A temperature of 110° to 120° has been found much more effective in increasing renal secretion than a lower tem-

perature. After colonic flushing, even within an hour or two, a large quantity of clear urine is frequently passed. The author has observed this personally in a number of instances.

In aggravated cases of habitual constipation in autointoxication a free colocolyster may be administered once daily for a week or ten days, or even longer, surely as long as gaseous distention of the bowels and fetid flatulence are complained of. It is best to have these colonic flushings given at night, so that the patient may rest and sleep without a sense of weakness. Occasionally, after the hot water has been introduced and discharged, a pint or two of water at from 70° to 85° should be injected, as a tonic bath, to stimulate the colon and rectum, by exercising the muscular structures and energizing the controlling nerves and nerve centers in the bowel wall.

The *graduated* enema is very rationally and rightly recommended by Kellogg as an exceedingly useful mode of overcoming the enema habit by weaning the bowel from the frequent necessity of distention with warm water in order to provoke an evacuation. Each day the amount of water is diminished and the temperature lowered. "Beginning with three pints of water at a temperature about that of the body, the amount of warm water introduced each day is diminished by half a pint, one-fourth pint of cold water being added, making the total amount of the fluid one-fourth pint less each day. At the end of the twelfth day the enema will consist of four ounces of cold water."

Sometimes a preliminary clearing of the rectum is necessary, by means of a simple enema of warm water, before the high injections are begun. In acute cases of autotoxemia the colonic flushing may be repeated after resting intervals of an hour or two until evidences of improvement are distinct: the pulse becoming fuller, the headache and delirium disappearing, the dry mucous membrane becoming moist, and the general appearance favorable. It is quite usual to note at the same time a marked reduction of fever.

Abrams suggests in some cases the double-current method of colonic irrigation, which permits of continuous irrigation and allows the small intestine to evacuate the contents into the lower bowel. Either Bodenhamer's or Kemp's rectal irrigators have been found useful for this purpose. Various antiseptics have been suggested in connection with irrigation of the colon, such as the following: potassium permanganate (10 grains to the pint); formalin (2 or 3 drops to every 2 or 3 ounces of the irrigating fluid). In cases of marked debility a simple salt solution may be used for irrigation purposes.

Intestinal Antiseptics.—There is no known general antiseptic treatment directed to neutralizing the intestinal toxins as they may occur in the blood. We are left, therefore, to seek measures to neutralize the poisons as they may occur in the lumen or mucous surface of the bowel.

Whether or not certain so-called intestinal antiseptics are really efficacious in the treatment of intestinal autointoxication has not been fully decided. That they may at times be at least partly beneficial in antagonizing poisons already formed within the bowel, and that they may be distinctly useful in inhibiting a profuse and dangerous growth of bacteria, cannot be denied. On the other hand, the problem is to be able to apply antiseptics strong enough to destroy bacteria without at the same time injuring the intestinal mucous membrane, and, likewise, at the same time destroying the innocent germs which are concerned in digestion.

If intestinal antiseptics are to do any good they must possess slight solubility and be, therefore, slowly absorbed, so that they can traverse the length of the intestines. Some writers doubt efficacy of intestinal antiseptics *in toto*, maintaining that there is no proof that they diminish the quantity of ethereal sulphates in the urine, or the quantity of indican. The experience of others is quite to the contrary, and leads many to affirm a marked benefit following upon the administration of intestinal antiseptics. The condition of the stomach and kidneys should certainly be carefully regarded, as some of the antiseptics commonly used are somewhat irritating, if not nauseating and disturbing to digestion; but also, as with some of the synthetic products containing salicylic acid and phenol, may be distinctly deleterious to kidney function and structure. Among the most useful of the intestinal antiseptics are naphthalin, thymol, the phenolsulphonates, subnitrate and salicylate of bismuth, salol or phenyl salicylate, and hexamethylenamin. Beta-naphthol, in doses of two or three grains, combined with a sixth of a grain (0.01 gm.) of thymol and two or three grains (0.15 gm.) of bismuth salicylate, and an eighth of a grain (0.008 gm.) of podophyllin, have been found useful, administered three or four times a day in soluble capsules. Salol may be given in five-grain doses every three or four hours. Urotropin (hexamethylenamin) is best given in simple watery solution, in five- to ten-grain (0.30-0.60-gm.) doses, with the simultaneous drinking of a tumblerful of water. The phenolsulphonates of zinc and sodium are also of recognized benefit.

TREATMENT OF CONDITIONS AND SYMPTOMS ASSOCIATED WITH INTESTINAL AUTOINTOXICATION

Habits of Living.—While it is true that in some rare instances a hereditary predisposition to the formation of intestinal autotoxins due to bacteria is met with even under conditions of ordinary dieting and moderate living, nevertheless it is most often the case that autotoxemic symptoms are the result of ill-adjusted habits of eating and exercising which are acquired under the stress and strain and irregular habits gen-

erally of modern civilization, especially as regards life in our big cities. That the whole subject of autointoxication of intestinal origins is becoming increasingly important is due to the fact that more and more people complain of work being irksome; that one rises in the morning not feeling refreshed; that the "tired feeling" and general debility is so predominant, and that the spirit of indifference and laziness generally appears to be on the increase. These prevalent symptoms are not by any means always due to brain fag, or to overwork or age, or even to worry and habitual fear, which are the curse of so many individuals. On the other hand, the physician who studies the physical condition and habits of his patients, even when they are not seriously ill, will not have to look far to find the proof that autointoxication is the underlying cause of these maladies. It is remarkable how soon improvement results when many of these patients are treated specifically and systematically by preventive and regulative measures of eating, exercising, bathing, and rigid attention to the eliminating functions. Many men in municipal life who eat the characteristic American breakfast of sausage and hot cakes, steaks and chops with fried potatoes, all washed down with copious draughts of strong coffee, will not wonder that their morning hours pass heavily, that they feel dull and listless, or irritable, while they sit for the whole forenoon in an office chair, get no exercise, and sometimes smoke strong cigars while attending to business. They have no chance to eliminate the toxins and carbon-dioxid accumulations. Again, some men not only eat too heavy a breakfast, but a nitrogenous and full midday luncheon, and there is an afternoon repetition of the forenoon's experience. A full or full course dinner at night adds still more strain upon the emunctories; and, later still, an after-theater supper adds insult to injury and provokes such an accumulation of toxins that nature's rebellion is not to be wondered at. The lassitude after a heavy meal is due, among other things, to the resorption of toxic peptones. Not infrequently I have met with instances where the best thing that happened to individuals who had fairly gorged themselves was an attack of violent vomiting within an hour after the heavy meal; otherwise severe intestinal autointoxication might have resulted. As a rule, people who overeat, especially heavily of nitrogenous food, at the same time drink too little water, so that their kidneys are habitually clogged with retention products. Thus are sown the seeds of rheumatism, gout, cardiovascular and renal diseases.

As a general measure to prevent retention of carbon-dioxid and intestinal toxins not only should the diet be reduced and regulated according to the principles already laid down, but exercise in the open air or with undergarmented bodies in well-ventilated rooms should be strictly insisted upon. The various body-bending exercises with deep inspiratory and expiratory chest movements, bathing exercises, sawing and chopping wood, golf, walking, tennis, Indian club and dumbbell exercises, boxing,

and fencing are all to be recommended to promote normal intestinal digestion and prevent formation of toxic decomposition products.

In the dietary, emphasis should be laid, of course, upon the elimination of all meats for breakfast except the occasional use of fresh fish or a bit of crisp bacon. The breakfast should consist, preferably, in order of sequence, of a cup of hot water with a little lemon juice added, drunk about ten or fifteen minutes before eating; then a cereal; then an egg or two, soft boiled or poached or shirred, or in the form of an omelet, but not fried; a roll and butter should be eaten at the same time; either cooked or raw fruit in season should go with practically every breakfast; sometimes raw fruit is better tolerated by the stomach after than before breakfast. For the luncheon and dinner sandwiches, the green vegetables, fruit and nut salads, and the lighter desserts are all allowable. Heavily spiced meat preparations, such as croquettes and deviled dishes, should be tabooed in particular. In this way intestinal putrefaction soon becomes markedly diminished, elimination is rendered freer, the patient feels lighter, brighter, more energetic, hopeful, and cheerful than ever. Water is prohibited at meals except in small sips. Alcohol is forbidden. The morning cold slap-bath, for a minute or two, adds tone to the circulation and skin elimination. After becoming accustomed to water used in this way for a summer and winter season, morning immersions may then be practiced in water at a temperature of 85° or 90°, to begin with, and gradually taken colder to about 75°, as long as the reaction, as shown by the increased color of the skin, promptly follows. Wide-mesh underwear, either linen or cotton, should be worn summer and winter, simply increasing the weight of the fabric for very cold weather. Alkaline mineral waters should be recommended, such as Vichy, Nuvida, and the Laurentian water of Canada.

Habitual Constipation.—Closely associated with unhygienic habits of eating in the production of intestinal autointoxication are habits of constipation. The absorption of poisons from the latter cause has given rise to the term copremia, which, however, has lost its current expression in the substitution of the phrase intestinal autointoxication. For, it is undoubtedly true that such symptoms may arise from a slow passage of feces through the intestines, by giving more time for the absorption of the products of bacterial decomposition. What the precise poisons are which produce autointoxication in constipation is not yet definitely known. We must recognize the fact that constipation alone is not always responsible for the symptoms of autointoxication: some individuals are unaffected by prolonged retention of large quantities of feces; in others a postponement by a few hours of the daily evacuation at once causes considerable discomfort. Also, some individuals seem to become autointoxicated unless they have two or even three bowel movements daily.

Should localized pain be manifest in certain cases of habitual consti-

pation with autointoxication it is not improbable that a stercoral ulceration has been produced by the retained feces. In such cases, naturally, the raw surface has lost the defensive epithelium of antitoxic function and also permits more rapid absorption of the poison. Again, cases of constipation with autotoxic symptoms may have associated liver disease to account for the latter; or an intestinal indigestion may account for the symptoms of autointoxication which the constipation alone might not produce. In short, it is of prime importance to keep the bowels regular in all chronic diseases, whether functional or organic, because of the tendency to aggravation of symptoms by constipation in those who are thus more susceptible to its intoxicating effects. Not infrequently we find in the course of such diseases as typhoid fever, tuberculosis, and practically in all infectious diseases a rise of temperature or a retardation in the drop of fever to be due to a constipation autointoxication.

Space forbids even an outline description of the treatment of the multitude of symptoms due to autointoxication from habitual constipation. It must suffice here to indicate briefly some of the disorders which are thus attributed to or aggravated by autointoxication from this source. Of *diseases of the alimentary tract* chronic catarrhal colitis, with or without ulceration, mucomembranous colitis, appendicitis, enteroptosis, as well as intestinal indigestion, are the most important. Bouchard attributed to dilatation of the stomach many cases of autointoxication. The association of intestinal flatulence with habitual constipation is a frequent evidence of the development of decomposition products giving rise to symptoms of autointoxication. In cases of prolapse of the bowels the relief of this condition along with the constipation causes a subsidence in symptoms of autotoxemia as well. The treatment of enteroptosis is thus often the primary course in the treatment of an associated toxemia secondary to the motor insufficiency common to this malady.

As the dominant part of a general condition a visceroptosis will need attention directed to those environmental factors which are responsible for the production of the affection, characterized as it is by evidences of physical decline, laxity and debility of fiber, involution, and often a neurotic degeneracy. The excesses and irregularities of living, education, amusements, and the like have to be checked; the defensive, adaptive, and recuperative powers generally strengthened, and augmented if possible. Proper abdominal support obtained at the same time, the bowel tone improves, and intestinal stagnation and consequent toxemia diminish and disappear accordingly.

In the author's experience chronic catarrhal appendicitis with constipation is a very common cause of symptoms of intestinal intoxication. The removal of the appendix is invariably followed by improvement in this respect and as regards intestinal digestion and the general assimilation. This holds true even where a constipated tendency still remains.

The Liver.—Where constipation is associated with symptoms of catarrhal jaundice it is not improbable that autointoxication of intestinal origin is to blame for the jaundiced condition.

Atrophic cirrhosis of the liver has been attributed too much to alcoholism. While alcohol produces fibrous changes in the liver, it is probable that more cases of cirrhosis are autotoxemic than alcoholic in origin, particularly as constipation is usually a prominent associated condition. Experiments by Boix showed that the various acids and cresols of intestinal fermentation and putrefaction, as well as the toxins manufactured by various bacteria, including the colon bacillus, could produce atrophic cirrhosis of the liver. In the normal state the liver resists these poisons. If it becomes enfeebled or is already congenitally weak, toxic action takes place and hepatic cirrhosis by autoinfection of gastrointestinal origin supervenes. The so-called enlarged dyspeptic liver is more affected by congestion than cirrhosis, and varies in size according to the attacks of indigestion. In time, however, this simple enlargement may become transformed into a true cirrhosis, due to the absorption of the poisons from a constipated intestinal tract by a liver which is steadily losing its capacity for dealing with them.

Several cases have been described by English writers in which periodic or cyclic attacks of severe vomiting with great prostration and fever were associated with constipation; the urine was scanty and contained acetone and diacetic acid, also indole during the paroxysms. While cyclic vomiting very often depends upon acidemia there are undoubted cases where the conclusion must be that the attacks result from active intoxication in the portal area from absorption of intestinal toxins.

Forchheimer has observed associated with chronic intestinal autointoxication and fecal accumulations in the colon Riggs' disease of the mouth as a frequent symptom. This condition has improved under treatment directed to regulation of the bowels, flushings of the colon, and the use of an antiputrid diet.

Circulatory Disorders.—Constipation with autointoxication is responsible for many instances of palpitation of the heart, particularly in neurotic individuals. Various vasomotor disturbances, such as coldness of the extremities, flushings of the head, and vertiginous attacks are ascribable to the autointoxication produced by constipation.

Daily demonstration is met with in modern medical practice of the subtle but sure effect which gastrointestinal poisons have upon the development of hypertension in the arteries, later leading to actual arteriosclerosis. Metchnikoff believes that his experiments with paracresol and indole show that these substances are capable of inducing chronic lesions of the nature of sclerosis. Such lesions are the very ones that are encountered most frequently in senility. It seems to be established beyond question that the colon bacillus and other bacteria produce poisons which can

be absorbed by the normal walls of the intestines and are capable of inducing insidiously serious lesions in the arteries, kidneys, liver, heart, etc. It is in these cases that the systematic and continuous use of Bulgarian lactic acid bacilli in milk preparations is especially indicated.

Anemias.—It is not so long ago that chlorosis was attributed to gastrointestinal intoxication due to fecal accumulations and habitual constipation. While this theory has been disproved there is no doubt that pernicious anemia and perhaps some cases of secondary symptomatic anemia are due to hemolytic agents of toxic nature absorbed from the alimentary tract and entering into the portal system. It should be recognized at the same time that constipation may aggravate a chlorosis by autointoxication.

Metabolic Disorders.—To what extent precisely the commoner diseases of nutrition are due to the absorption of gastrointestinal toxins we do not know; but that they operate in the production of such chronic affections as rheumatism, gout, diabetes, and obesity is not to be doubted. This statement is enforced by the frequent occurrence of constipation in these diseases. Wasting of the body, even to emaciation, may also be ascribed to unhygienic bowel habits, constipation, and excessive katabolism resulting from intestinal autointoxication. In all such cases a diet arranged according to the requirements of the particular disease relieves the constipation and at the same time the associated autointoxication which tends to make the development of the nutritional disorder persistent.

Whether the causes of intestinal autotoxemic arthritis are specific organisms, or excessively abundant nonpathogenic bacteria absorbed into the blood, or metabolic chemic irritants of abnormal digestion, the practical therapeutic indication remains that intestinal asepsis is to be aimed for by regulation of diet and proper attention to the evacuations. Clean, unadulterated, fresh nonfermenting and notputrefying food only should be allowed, avoiding particularly excess of starches and sweets, such as pastries, sweet and white potatoes, griddle cakes, oatmeal, cake puddings, fancy icing and layer cakes, syrupy preserves, and the like; also such meats as mutton, fresh pork, sausages, croquettes, deviled meats, cold-storage chicken and eggs, etc.

Arthritis of intestinal origin may not infrequently be proven by the therapeutic diagnosis of almost immediate relief of pain by intestinal lavage, free purgation, and dietetic management. Cases are by no means rare that show undoubted connection between arthritic symptoms and intestinal toxemia due to fecal accumulations and impactions, relief having been obtained by daily physiologic salt solution enemata, by the postural-gravitation method. Patients with arthritis who respond to intestinal treatment habitually eat a little more than their digestive tract is able to properly care for, and intestinal putrefaction occurs with them in consequence very frequently and excessively, yet subject to usual fluctuations. It is in these cases of chronic rheumatic, gouty, and rheumatoid arthritides

that long-continued methods of diminishing the formation and absorption of intestinal toxins is specially needed for any degree of substantial improvement. Besides the relief of constipation there must be modifications in the diet, intestinal antiseptics, lavage of the stomach and colon, abdominal massage, and, at times, electric applications, particularly of the sinusoidal current. Some practitioners find a reliable preparation of colchicin to be distinctly useful in the treatment of gout associated with underlying constipation and intestinal toxemia.

Respiratory Disorders.—There is justification for believing that some cases of acute dyspnea are of toxic gastrointestinal origin where constipation is extreme at times, or more or less chronic. Asthma and emphysema are certainly aggravated in connection with dyspneic attacks if they are not directly produced by intestinal toxins. I have seen the fever and shortness of breath in cases of pneumonia promptly improved in stubbornly constipated individuals by a thorough evacuation of the bowels; the toxic symptoms having been apparently more intestinal than pneumococcic in causation. In the care of tuberculosis it is my belief that not sufficient systematic attention is paid generally to the condition of the alimentary canal and the prevention of bowel accumulations with resultant intestinal autointoxication. Many cases of pulmonary tuberculosis are relieved decidedly as to fever, bodily force, mental attitude, and functional vigor throughout by colonic flushing. Indeed, intestinal autoinfection seems in many cases to retard progress in gaining weight and strength as much as the mixed infection which is so frequently met with as a complication of the primary tuberculosis.

Nervous System.—Gastrointestinal intoxication is held to be responsible for a large number of disorders of the nervous system in which constipation is simultaneously a constant feature. Among these may be mentioned migraine, neuritis, epilepsy, psychasthenia, neurasthenia, myasthenia, dementia, certain psychoses, and even paralysis. In such disorders the evidence of intestinal toxemia appears in the recognition of dietetic errors, the occasional occurrence of acetonuria, toxicity of the urine and perspiration, and often the excessive elimination of aromatic sulphates.

Headache is one of the most common symptoms of constipation of the habitual type. Persons who are subject to headaches from other causes are particularly liable to suffer when they are constipated and autointoxicated. In these patients at times relief can be obtained only by thorough lavage of the colon.

Neuralgia is undoubtedly produced by intestinal putrefaction in certain individuals of constipated habit.

Fatigue of body and mind, out of all proportion to the actual amount of exertion put forth, may often be relieved by treating the underlying constipation and autointoxication by purgation and colonic flushings. Insomnia, nightmare, and, in children, grinding of the teeth and night ter-

rors, are also subject to intestinal toxemia, particularly in those of neurotic predisposition. Patients suffering from neurasthenia, melancholia, hypochondriasis, and allied conditions are much more sensitive to the toxic effects of intestinal putrefaction than are those who have a normal nervous system. There is here illustrated a vicious circle: that is, depressed conditions of the nervous system very readily lead to constipation and autointoxication; and the latter condition, in turn, aggravates and excites the nervous symptoms.

It is in cases of psychasthenia and neurasthenia especially where it is necessary to follow systematic cleaning out of the bowel, along with whatever treatment may be indicated in other lines, such as massage, baths, electricity, and the like. No matter what other treatment may be applied, a successful issue is not obtainable unless the usually associated intestinal autointoxication is at the same time radically overcome.

Vertigo and tinnitus aurim have been noted as prominent symptoms in undoubted cases of intestinal toxemia that have been relieved within an hour where lavage of the colon has been practiced.

Although it has not as yet been definitely proven that epilepsy is due to gastrointestinal intoxication it is increasingly probable that some obscure poison or poisons generated in and absorbed from the intestinal tract are responsible for a large number of the cases. It is certainly true that epileptic patients treated dietetically and medicinally along these lines do improve as to frequency and severity of convulsive attacks.

Herzfeld affirms positively the excellence of quinin hydrochlorid in 0.5-gm. doses (one or two) in the preventive treatment of migraine and anaphylaxis associated with gastrointestinal intoxication.

Ocular Affections.—Risley, De Schweinitz, Ziegler, and other well-known oculists have shown conclusively that the intestinal tract is often the source of autotoxemias which are directly or indirectly responsible for such ocular diseases as blepharitis, keratitis, iritis, and certain neuroretinal lesions. In connection with the absorption of intestinal toxins from putrefactive decomposition it has been found in some instances that prolonged constipation is liable to cause recurrent intraocular hemorrhage. These eye conditions can be relieved only by the most studied attention for a long time to the correction of gastrointestinal errors by dietetic, digestive, antiseptic, and purgative measures. Even in so mild a symptom as occasional *muscæ volitantes* it is advisable to relieve a constipation and signs of putrefaction which are not infrequently associated.

Cutaneous Disorders.—It is a common observation that urticaria, erythema, and angioneurotic edema, as well as pigmentation of the skin, especially around the eyes, may all be due to intestinal autotoxemia, with or without chronic constipation. Some of the eczemas are likewise of gastrointestinal toxic origin in children as well as in adults. The recent doctrine of anaphylaxis as applied to the alimentary canal rationally explains

the marked affinity for putrefactive substances which the skin manifests in those having systems peculiarly sensitized to certain articles of diet, such as strawberries, cheese, crabs, clams, pork, veal, buckwheat, etc.

Psoriasis is a typical example of chronic skin disease where the avoidance of meats (proteids) is a *sine qua non* for successful results. This means that intestinal putrefaction is reduced to a minimum if not prevented altogether.

Some authorities maintain that dipsomania may be excited by an acute intestinal toxemia; and it is true that a helpful element in the treatment of alcoholism in its various forms consists in vigorous and sometimes heroic measures directed to cleansing the lower bowel.

In the treatment of the uncontrollable vomiting of pregnancy it should not be forgotten that this symptom may be due to the absorption of intestinal toxins.

Lynch, of New York City, has recently pointed out a relationship between chloroform post-anesthetic poisoning, due to autointoxication instead of sepsis as was previously supposed.

In the way of final dietetic suggestions to aid in keeping the bowel movements regular, soft, and free, and to reduce as much as possible the tendency to putrefactive changes within the intestine, the following articles should be given frequently and abundantly: Graham and rye bread, butter and olive oil, fresh, luscious fruits, buttermilk, cider, beer, green corn, cabbage, cauliflower, carrots, cress, celery, lettuce, sauerkraut, onions, spinach, honey, marmalade, salt herring, milk sugar, old-fashioned molasses, prunes, dates, figs, raw and cooked apples with the skins, English walnuts, etc.

In the prevention of the chronic degenerative diseases of modern civilization the early detection and energetic and constant regulation of auto-toxic tendencies and processes is bound to play a predominant part; and the control of these will largely depend upon the control obtained in preventing and treating successfully the abnormal bacterial and chemical decompositions, and the disorders of the gastrointestinal tract.

III. CONSTITUTIONAL DISEASES

CHAPTER I

DISEASES OF THE MUSCLES

CHARLES LYMAN GREENE

VARIOUS FORMS OF MYOSITIS

1. ACUTE POLYMYOSITIS

(*Dermatomyositis—Pseudotrichinosis*)

First described by C. Wagner as dermatomyositis in 1886, this disease presents a peculiar combination of almost universal progressive interstitial myositis of high grade, with a considerable fever (104° F.), severe pain, acute tenderness, marked and ultimately complete disability, edema and redness of the overlying skin and involvement of the subcutaneous tissues. The muscles show more or less marked induration.

The onset is usually gradual, with the usual symptoms of an acute infection, but lacking chill and high fever.

This stage is succeeded by severe cramplike pains and marked tenderness in the affected muscles.

The disease usually attacks the proximal muscles, first of the upper, later of the lower extremities, and extends distally.

The tongue, muscles of deglutition, ocular muscles, diaphragm, and accessory muscles of respiration usually escape.

Cases have been reported by a number of clinicians, and the disease seems to represent a distinct clinical entity. Mild cases occur in which but few or even one muscle alone may be affected.

The spleen is usually enlarged, and albumin may or may not be found in the urine.

The specific cause is unknown, but its infectious nature seems to be clearly indicated.

It is unlikely to be confounded with any ailments save polyneuritis and trichinosis. From the former it is easily distinguished by the seat and distribution of its pain and tenderness. From the latter, by its ap-

pearance as an isolated case, the absence of eosinophilia and of parasites, and the rarity of early involvement of the eyelids, jaws, or larynx.

Examination of the blood, the stools, and of a bit of the muscle itself will also serve in any case of peculiar difficulty, and such a procedure must often be essential to an unequivocal diagnosis.

The prognosis is grave in severe cases, good in the case of limited lesions. The disease seldom subsides within a period less than a month or six weeks, may endure for months or become chronic and last for one or two years.

Cases in which the symptoms are more trivial and evanescent are reported but seem atypical and, in many respects, dubious.

Treatment.—Lenhartz and Stinzing advise the hot, dry packs, support, elevation, and relative immobilization of the affected members. The use of cotton packing and light bandaging to secure warmth and, if possible, exert gentle continuous pressure is desirable.

Aside from these means relief of any persisting pain must be sought through the use of aspirin, salipyrin, phenacetin, antipyrin, or salicylates and morphin may be employed if other means fail. In persistent or chronic cases massage is valuable, as are faradization and galvanization of the muscles affected.

[In one case of dermatomyositis, collargolum given in suppository seemed to have the most remarkable effect, the patient recovering.—Editor.]

A weakened heart may require appropriate stimulation, and a generous diet as soon as the fever will permit.

2. SYPHILIS OF THE MUSCLES

Disease of the muscles of luetic origin may be encountered, either in the secondary or tertiary stage of syphilis. In the former it may take the form of a peculiar swelling, and later induration, circumscribed, or diffuse infiltration of certain muscles, associated with little or no tenderness on pressure, save that obtained over the point of attachment of the tendon. Fever is usually present, but seldom or never high. Spontaneous pain and tenderness are alike absent in the muscle itself. It is peculiarly likely to select the biceps or the rectus femoris as its seat and to appear later in the secondary stage or the earlier months of the tertiary stage of the disease. The muscle tendons may be involved either during the secondary or tertiary stage, and the irritative form may closely simulate acute rheumatic tenosynovitis.

Muscle syphilomata are almost painless circumscribed luetic tumors limited strictly to the muscular tissue, and appear during the tertiary period. Under treatment they may disappear without other manifestations than the formation of scars, or they may soften and burst outward.

The sternomastoid and tongue are the muscles most often affected, but, as is well known, syphilis may appear in any muscle, and even in the myocardium.

Treatment.—The treatment is that of syphilis elsewhere in the body—mercury or salvarsan.

3. PRIMARY ACUTE SUPPURATIVE MYOSITIS

Acute suppurative myositis is a rare acute infectious disease characterized by inflammation of a single muscle or of several muscles, terminating in diffuse purulent infiltration, localized single abscesses, or multiple purulent foci.

The disease affects but one muscle in about one-half the cases, and seldom involves more than two.

First described in 1869 by Foucault, it has been especially studied by Suard, Nicaise, Walther, Brunon, Scriba, Lorenz, and Steiner, while certain Japanese investigators, notably Miyake, have added much to our knowledge of the disease and reported 250 cases.

A large literature is now available bearing upon the etiology of the disease,¹ but so far no specific germ is proven, and the staphylococcus pyogenes aureus seems to be most constant in the lesions. Neither has any definite portal of entry been discovered, and it would seem that the sources of infection may be varied, and that muscle injury and overstrain are the chief predisposing factors.

It affects the male more frequently than the female, is seen chiefly in young adults and children, and is encountered usually among the laboring classes. The etiologic factors are thoroughly discussed in Steiner's admirable article.

The clinical picture is that of an acute suppurative process. The onset is usually sudden with chill or chilliness, fever and sweating, general prostration and bone joint and muscle pains. A swelling soon becomes manifest in the muscles, which are extremely tender and painful.

In the long muscles the induration is spindle shaped, in the broad muscles hemispherical.

The signs of suppuration soon become manifest in most cases, and the treatment is essentially surgical.

The affected muscles are extremely painful and their tonic contraction involves corresponding changes of a fixed character in the position of the members or portion of the trunk affected.

Prompt recognition of the nature of the ailment and appropriate and judicious surgical treatment are usually effective and the actual mortality is low.

Atrophy of the muscles or extensive replacement of muscle by scar

tissue may cause more or less marked deformity, but usually the patient's recovery is uneventful.

Treatment.—The entire management of the case is surgical.

4. SECONDARY SUPPURATIVE MYOSITIS

It is unnecessary to discuss, under a separate heading, the manifold instances of this complication of the acute infectious diseases from glanders through the long list embracing erysipelas, typhoid, malignant endocarditis, etc.

5. TUBERCULOUS MYOSITIS

This is a rare condition occasionally observed in connection with miliary tuberculosis and appearing in certain muscles as a diffuse infiltration.

Such cases represent primary hematogenous tuberculosis of the muscles in contradistinction to the secondary forms.

6. MYOSITIS FIBROSA

This condition is almost invariably a distinctly secondary process associated with simple or septic chronic inflammatory changes in the muscles or the neighboring joints. It may play a part in primary or spinal muscular atrophies or even follow extensive chronic eczema and ulcer.

Treatment.—The treatment is largely limited to massage, passive movements, and orthopedic resources.

7. MYOSITIS OSSIFICANS

This extraordinary disease is a clinical curiosity and its victims among the poorer classes are likely to fall into the hands of the side-show and dime-museum proprietors.

The extraordinary pathologic change involves not alone the muscle fibers but the interstitial connective tissue, the aponeuroses, and the tendons.

Injury, chronic disease of the joints, excessive muscular strain and the like are usually the antecedent factors.

A spontaneous progressive polymyositis ossificans may occur and usually first develops in youth. In such cases the muscles of the back and neck are likely to be first involved.

The disease passes through stages representing (a) infiltration, (b) fibrous deposits, (c) bone formation.

Treatment.—The disease is progressive and entirely beyond the reach of any effective therapy.

MUSCULAR RHEUMATISM

(*Myalgia*)

The dubious terminology used in relation to this common and painful ailment expresses the uncertain nature of our knowledge of its etiology and pathology.

In the domesticated lower animals no less than on men one sees examples of muscle tenderness, disability, and pain following exposure to cold after overheating or coming on after unusual exercise. One muscle, a muscle group, or many muscular areas may be involved. Hence we find torticollis ("stiff neck"), lumbago, pleurodynia, stiff shoulders, hips, legs, arms, and the like common events in every-day life.

Such cases are usually painful only during movement, and in only a few instances is there fever. The onset may be either sudden or gradual, the duration, usually short, may vary from a few hours to weeks, or even months.

No definite cause is positively known, though congestion, inflammatory, and even exudative changes in the muscles have been suggested, though without wide acceptance. That it can occur without a specific chronic infection or, indeed, any form of toxemia seems proven. On the other hand, it is quite frequently observed in connection with acute and chronic rheumatism and chronic gout. In the writer's experience it has been encountered with special frequency in those who have suffered from, or are subject to, rheumatism, tonsillar and nasopharyngeal infections, or chronic disturbances of digestion.

The diagnosis is seldom in doubt, save in cases simulating trichiniasis, and in these the absence of certain leading symptoms of that infection, such as edema of the face, involvement of the muscles of mastication, wide distribution of the muscular lesions, eosinophilia, and the like, usually prevent error.

It lacks the well-defined tender points, definite distribution, and paroxysmal and spontaneous pain of the neuralgias, the joints are unaffected, such tenderness as is present is clearly and definitely muscular, and pain is markedly increased by putting the affected muscles in action and greatly and promptly relieved by rest. Myalgia may accompany rheumatism or be associated with neuralgia, in which event the picture is far more complicated.

Treatment.—Myalgias are oftentimes suggestively responsive to anti-rheumatic remedies of all descriptions and especially to aspirin and antipyrin.

The homely, old-fashioned method of "ironing" the patient's muscles

with hot flatirons over sufficient folds of blankets or towels is an excellent form of treatment, combining massage with the application of heat.

Repeated deep puncture with needles is of unquestioned value if cleanly done, but all these maneuvers must be combined with rest.

Counterirritation by means of mustard, capsicum, and the like may assist a slowly progressing case, and many authorities advocate hydrotherapy, the electric-light bath, and various forms of electric treatments.

Hydrotherapy combined with massage is of undoubted value in chronic cases, as is a nourishing but plain dietary.

MUSCULAR CRAMPS

These affect chiefly the calves of the legs, the feet, and less frequently the other muscles of the lower extremities. They come on suddenly, more often at night, and are extremely painful and troublesome. They may be only momentary in duration, but often last for from fifteen to thirty minutes, and they occur almost wholly in persons suffering from overexertion or some form of acute or chronic intoxication.

One encounters them in connection with gout, chronic nephritis, diabetes, alcohol, lead, and arsenic poisoning, and in connection with overuse of the muscles associated with extreme fatigue. Cholera, typhus, and even acute diarrheas or dysenteries are well recognized causes.

Treatment.—Friction, kneading, and hot applications give most relief.

The sudden application of a cold substance to the sole of the foot is sometimes effective when other measures fail.

The cause should be sought and receive appropriate treatment. If due to overuse of the muscles a supporting bandage is often of value.

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CHAPTER II

GOUT

(*Arthrosia Podagra*)

CHARLES LYMAN GREENE

Definition.—An ailment associated with hereditary or acquired inability on the part of the organism of the affected individual to produce and maintain sufficiently active ferments (oxylases and nucleases) to bring about those chemical changes in the exogenous and endogenous purin bases necessary to the maintenance of good health.

The most characteristic clinical features of gout are:

- a. The persistence of uric acid in the blood even under a purin-free diet (i. e., eggs, cream, milk, olive oil, and other fats, cheese).
- b. That under such a diet the excretion of endogenous uric acid (that not derived from food rich in nucleins but from the patient's own tissues) is abnormally slight.
- c. That during an attack of gout the urinary uric acid content rises sharply and promptly falls below normal at its close.
- d. That victims of gout placed upon a diet rich in purin bodies (thymus, pancreas, liver, etc.) fail to show the marked increase of exogenous uric acid excretion by the urine found in the normal individual.
- e. The tendency to uratic deposits in the joint tissues in chronic cases and the formation of tophaceous deposits there and elsewhere.
- f. The tendency of the disease to attack metatarsophalangeal joints and in acute seizures that of the great toe with peculiar frequency.
- g. The frequency of larval and irregular gout of peculiarly protean and baffling symptomatology.
- h. The tendency of the disease to change its form and pass from the stage of acute seizures followed by wholly symptom-free intervals to that chronic form associated with permanent changes in the joints and other organs (kidneys, stomach, intestines, heart, and blood vessels), with greater or less impairment of health and strength.
- i. The tendency of the disease to develop its severer manifestations after the third decade of life.

Etiology.—The exact etiology of gout is unknown.

Inheritance plays a large part, but indolence and physical inactivity with their resulting loss to metabolism are important factors, especially if they be combined with those habits adequate in themselves to excite attacks, i. e.,

- a. Gluttony, or the consumption of large amounts of animal foods, highly spiced, rich dishes, and the like.
- b. The overuse of alcohol and tobacco.
- c. Excessive worry and mental strain.
- d. Chronic lead poisoning.

The investigations of the last decade have thrown a flood of light upon the disturbed metabolic processes associated with gout, and added considerably to our knowledge of its dietetic management. Nevertheless, much remains to be explained.

The changes wrought in the purin group through the action of oxygen on the one hand and NH_2 on the other evidently lie at the root of the deficient metabolism characteristic of this disease.

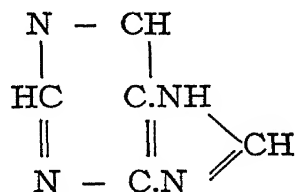
The purin bodies derived from the ingested nuclein-rich food, and those of the body tissues themselves (nucleins and nucleoproteids), become of chief importance in the modern view of gout.

As H. Lüthje, in his admirable article, expresses it, "Under normal conditions the greater the nuclein content of the ingested food the more marked is the excretion of uric acid by the urine, and in the normal individual the uric acid excretion curve is singularly constant for like conditions of diet, activity, and body weight, though varying considerably in different individuals."

In gouty individuals the excretion of both endogenous and exogenous uric acid is markedly diminished save during an acute seizure.

Uric acid is one of the substances belonging to the "purin group" which contains also adenin, guanin, hypoxanthin, xanthin, and caffenin.

Purin is represented by the formula



By the introduction of oxygen or NH_2 , or both, the oxypurins, hypoxanthin, xanthin, and uric acid, or the aminopurins, adenin and guanin, are formed.

The source of the purin bodies is nuclein, and their elaboration depends upon the presence of a sufficient amount of active ferments (nucleases, desamidases, and oxydases) in the human body.

AGE.—Gout is essentially a disease of the mid-period of life and typical attacks occur most frequently between the ages of thirty-five and fifty, and rarely under the age of thirty.

It shows a certain tendency to subside after the age of sixty, and on the other hand may appear in youth in children of badly tainted stock.

The disease is rarely encountered in women.

INHERITANCE.—In England from 75 per cent. to 80 per cent. of the gouty cases among the well-to-do clearly indicate an hereditary taint.

In public cases in London hospitals the percentage varies according to the location of the clinic and class of cases admitted, but has been placed at 50 per cent. plus by several English clinicians.

Fletcher reports from the Johns Hopkins Hospital clinic 31 per cent. of cases showing a tainted family history.

The inheritance may be either that of the main disease or of its alternatives, such as arteriosclerosis, chronic nephritis, gastrointestinal diseases, eczemas, and certain forms of diabetes, as well as the various forms of irregular and larval gout.

It is said that transmission from a grandparent through the unaffected mother is even more potent than direct transmission from father to son, yet women are far less likely to develop the disease, and in them it is excessively rare before the menopause.

It would appear from the reports of several observers that the inheritance of gout falls most heavily upon the later-born children.

LEAD POISONING.—The statistics concerning the frequency of a history of lead poisoning in gouty cases when compared with the ratio of inherited to acquired cases are almost beyond belief. Fletcher reports fifteen per cent. and quotes Garrod's figures, which showed antecedent plumbism in no less than 33 per cent. of his public hospital cases.

Sir Dyce Duckworth is quoted by Roberts as having observed 25 cases of lead impregnation among 136 cases of unequivocal gout observed in out-patients of both sexes. On the other hand Frerich of Berlin analyzed 163 cases of lead poisoning in the public wards, and could not find a single case of gout.

It would seem, as Roberts says, that lead impregnation markedly increases the predisposition to gout, but is only effective when it occurs in predisposed cases or in populations among whom gout is prevalent.

OCCUPATION.—Workers in lead and those engaged in breweries, taverns, and drinking places generally are predisposed through occupation.

Dealers in meat, especially such as are also heavy smokers and drinkers, also suffer not infrequently from gout.

AREAS OF PREVALENCE.—England is by far the most gout-ridden country; France and Holland come next; while, according to Eichhorst, Ger-

mans, Spaniards and Italians, Swedes, Norwegians, and Russians are comparatively free from it.

Normandy is said by Charcot to be especially affected as compared with the rest of France, and Scotland and Ireland suffer far less than England.

The consumption of strong wines and heavy ale rather than spirits would seem to determine its prevalence in great measure.

Symptoms.—The classical symptoms of acute gout are:

- a. Agonizing viselike pain in a metatarsophalangeal articulation, usually that of the great toe.
- b. Dusky redness of the affected area.
- c. Swelling, with tense, hot, glistening, overlying skin, and ultimately a slight superficial edema.
- d. Exquisite tenderness.
- e. Fever, rarely exceeding 102-103° F.
- f. Decided leukocytosis—14,000, 20,000.
- g. An excess of uric acid in both urine and blood (Garrod's thread test) at the height of the attack.

ONSET.—The attacks come on suddenly, usually in the early morning hours, but are usually preceded by premonitory symptoms sufficient to warn any patient who has previously experienced such seizures.

Such premonitory symptoms are:

- a. Loss of appetite or dyspepsia, with acid eructations.
- b. Bronchitis.
- c. Unusual restlessness, nervous instability, or attacks of mental depression.
- d. Fleeting pains in the smaller joints.
- e. Headache, insomnia, or unrefreshing sleep.
- f. Asthmatic symptoms, sore throat, or bronchitis.

The pain usually abates in the morning, only to reappear on succeeding nights with added intensity. One joint only may be affected, or the disease may appear in other articulations. An attack usually lasts for a week or more, gradually subsiding with desquamation and local itching, leaving behind it a tender swollen joint, which persists for a week or more in most instances.

Transient albuminuria may occur even in the absence of established renal disease. As has been stated, the urine is scanty and the output of uric acid, markedly increased during the acute seizure, promptly shrinks as the attack subsides, and is markedly diminished during the free periods.

CARDIOVASCULAR LESIONS AND GOUTY KIDNEY.—As is well known, the gouty habit and inheritance alike predispose to cardiovascular changes.

Arteriosclerosis is the usual accompaniment. It is usually wide-

spread and frequently associated either with a true contracted kidney or with that of the arteriosclerotic type.

GLYCOSURIA.—Gouty diabetes is well known as a complication. It is usually mild, essentially chronic in its course, and readily controlled by proper dietetic restrictions.

That such a condition should occur as a complication of gout is extremely interesting in its relation to the imperfect or perverted ferment production and activity which lie at the root of the disease.

ACUTE GOUT.—The factors precipitating a gouty seizure are often undiscoverable, but local joint injury, strains, and exposure to cold and wet are often the apparent causes; and fits of anger, psychic shock, or acute worry are undoubtedly sufficient to determine the explosion.

RETROCEDENT GOUT.—This faulty term covers cases in which the symptoms relating to the brain, gastrointestinal tract, or heart are unusually severe.

Delirium, stupor, coma, and apoplectiform attacks, excessive purging, and persistent or intractable vomiting are alarming symptoms which fortunately seldom occur. Precordial pain; rapid, irregular pulse, and severe dyspnea are likewise of an alarming nature and serious import, but these symptoms of severe toxemia furnish us no adequate ground for a separate type of the disease.

Fletcher rightly states that most of these individuals are uremic, and to this statement one may add that the cardiovascular changes of long-established cases are sufficient in themselves to account for nearly all of the symptoms.

Acute gout presents no serious diagnostic problems in differentiation.

CHRONIC GOUT.—The seats of predilection in gout are, in order of frequency, as follows: the great toe, tarsus, ankle, knee, hand, and carpus.

As the disease progresses in its chronic form the joints become thickened and deformed. Bursal inflammations are common, especially in the region of the olecranon and patella, and the chronic painful course is frequently interrupted by acute or subacute seizures with or without fever.

The tophi may form masses as large as a plum, but the Heberden's nodosities so frequently encountered in clinics are rare in gout and more often seen in connection with arthritis deformans of the hypertrophic type. These occur commonly about the terminal finger joints, seldom exceed a pea in size, are painless, and show no tendency to ulceration. They occur most commonly in women and during or after the menopause. Undoubtedly most cases of chronic painful multiple arthritis occurring in the male, and in gout-ridden countries, are due to gout, and this is especially true of such cases as are associated with marked arteriosclerosis or renal disease.

It is probable that the disease is on the increase in America, but good wine cellars, a life of luxury, heavy ales, and inordinate meat-eating are

still but slightly developed in the United States, and, in consequence, gout is relatively rare and in many regions almost unknown.

The chronic arthritis of women is more likely to represent arthritis deformans, or the rarer genuine chronic rheumatism, both of which are probably due to chronic infections or profound autointoxication.

IRREGULAR GOUT.—This comprises that vast group of symptoms arising in the case of tainted individuals who have escaped the acute manifestations of inherited or acquired gout.

The bastard term "lithemia" has been used to cover every diagnostic sin in the catalog of human ills, but is at present falling to the rear, as is also the term "gouty diathesis," which falls so pleasantly upon the ear of those hypochondriacal victims of gastric neuroses and their ilk, who feel that at last a safe anchorage is found in the snug but ample diagnostic harbor represented by an aristocratic ailment.

Irregular gout is a perfectly proper term, and the ailment merits most careful consideration. Its presence should not be predicated upon the mere presence of apparent excess of uric acid in the urine, as is so frequently done, for, in true gout, the uric acid curve runs below the normal and only by the most elaborate analyses based upon a carefully controlled dietary can one determine the endogenous and exogenous uric acid curve of the individual.

Hence, the absolute diagnosis of irregular larval gout is surrounded by too many technical difficulties to render it available for most practitioners. The tentative or probable diagnosis is only justified when the family history or habits clearly indicate the tendency in the individual.

The symptoms ascribed to it cover almost every variety of gastrointestinal disturbance, eczemas, herpes zoster, headaches, including migraine, and too often a mere psychasthenia or the "Congenital Universal Asthenia" of Stiller.

The treatment so often prescribed is therefore poorly adapted to many of the ailments so often sheltered by this too ample diagnostic cloak, and quite generally the diagnosis of "lithemia" is applied to cases which are of a nature directly opposite to gout in etiology and in therapeutic requirements, or to serious organic disease needing both correct diagnosis and selective treatment.

TREATMENT

PROPHYLACTIC TREATMENT

The prophylaxis of gout should begin in infancy. Fresh air and sunshine, a free use of pure water, proper clothing, a rational diet, and later abundant exercise should be sought.

In the later years every effort should be made to form such habits with regard to the systematic training of the body, moderation in eating, and especially

the avoidance of any excess of meats as are clearly indicated in the light of our knowledge concerning the vital part played by deficient or faulty metabolism.

Of quite as great importance is the matter of correct habits.

One of our English confrères has said that the inheritance of gout ordinarily means rather the inheritance of a good wine cellar. It certainly means that tendency, wrought by inheritance, environment, and racial traits, to over-indulgence in heavy foods, wines, and malt liquors so general in the countries in which gout is most prevalent.

Poor Man's Gout.—In this connection it must be remembered that gout is by no means a rich man's ailment. Any one who has served in the great out-patient clinics of Great Britain knows how frequently gout is encountered in those miserable wretches in whom extreme poverty and an overdeveloped taste for heavy ale and gross eating are combined. Nor can one who, in the city of London, has seen wretchedly besotted mothers treating babes and young children to heavy ale fail to understand the genesis of "poor man's gout."

The element of idleness and those factors represented by excessive mental activity, worry, and strain are alike to be avoided. Anger, worry, and psychic depression are exciting factors to be most sedulously avoided.

Curiously enough, it would appear, from the testimony of prominent authorities, that indulgence in spirits is less potent in the causation of gout than is the excessive use of heavy wines such as Burgundy and port, sweet effervescent wines, and malt liquors.

Futcher and others point to the decidedly greater prevalence of gout in England as compared with Scotland in proof of this contention. It would appear that the total abstainer and vegetarian will most nearly attain immunity from either the hereditary or acquired ailment.

Tobacco.—From the most recent investigations relating to the excessive use of tobacco, one of the most striking and illuminating of which is Erb's recently published article on "*intermittierenden Hinken*" (intermitting claudication), it would seem that the weed of solace might be a distinct source of danger to gouty subjects.

Erb found an astonishing tendency to this form of arteriosclerosis in well-to-do patients who were excessive or inordinate smokers, and his figures, based, as they are, upon the study of 500 patients, among whom 14 cases of "*intermittierenden Hinken*" appeared, are of unusual interest. It will be remembered that this disease is largely confined to those high in the social scale, who can best afford to indulge in expensive and heavy tobacco, and have the opportunity and leisure for the excessive consumption of tobacco.

Furthermore, the disease has in the past been almost exclusively found in the male, and it would seem that female smokers and drinkers have not yet multiplied sufficiently to seriously affect Professor Erb's statistics.

With all rules relating to prophylaxis one must include the free use of pure water and attention to the bowels.

DIETETIC MANAGEMENT

In relation to both prophylaxis and treatment the diet is of cardinal importance.

It is evident that the first dietetic principle demands the avoidance of any excess of substances rich in nuclein bases or nucleins.

The absolute prohibition of malt liquors, port, Madeira, sherry, and champagne is distinctly suggested, and indulgence in any alcoholic beverage must be at the patient's risk.

Pollock has clearly shown that alcohol exercises an inhibitory effect upon the ferments involved in the formation of uric acid, both exogenous and endogenous, and uric acid excretion is distinctly diminished under its use.

Lüthje has admirably stated the modern attitude in a recent article. He especially warns his patients against liver, thymus, kidney, brain, and even pancreas, which, it would appear, enter into the manufacture of sausages in middle and southern Germany. Caviar and fish roe generally are also especially condemned, as well as bouillons and meat extracts, which are rich in purin bases and distinctly harmful.

If these were the only substances to be avoided it would be easy to make a diet list for the gouty, but beef and red meats in general are rich in purin bases, and especially in hypoxanthin, though relatively poor in nucleins. Hence the more nearly he can come to a meat-free diet the better off is the patient.

Milk, cream, cheese, and eggs, with the maximum of fruits and fresh vegetables, and an abundance of water, make the best dietary.

Between the white and dark meats comparatively little difference is found in respect to the purin bodies, and it is almost as well to permit a little red meat once a day as to attempt the substitution of chicken.

The writer usually permits a minimum amount of any meat save those just mentioned as being especially rich in purin bodies, and one is likely to find that middle aged or elderly gouty subjects are often so confirmed in all the faulty habits which contribute to their ailment as to make some compromise necessary. Nevertheless, all concessions to fixed habits should be minimal and exactly defined.

Boiled meats are said by Ebstein and Umber to be distinctly less harmful than broiled or roasted flesh, and Lüthje would attribute this fact to the extraction of purin bases through the boiling process.

The fats are extremely valuable in appropriate cases as furnishing a relatively purin-free food of high caloric value to reinforce the somewhat attenuated dietary.

The total proteid intake should not ordinarily exceed 100 gms. per day, or, according to Umber, 0.8-0.9 gm. per kilo of body weight.

This amount is easily attained under a complete withdrawal of meats by the proper use of purin-free foods, as eggs, milk, and cheese.

Fruits are of especial value, and modern investigations show the lack of proper grounds for the rigid avoidance of carbohydrates even as represented by sugar.

All these may be freely employed if one insists upon that invaluable rule which insists upon moderation in eating as well as in drinking, and the maximum of recreative muscular activity.

The victims of acute gout especially should be placed upon absolutely purin-free diet for a week or more following an attack, and even in the absence of recent attacks a regularly recurring period of purin-containing food withdrawal should be imposed.

In chronic, irregular gout the greatest care is necessary to avoid undernutrition, and one is forced to steer his hazardous course between the Scylla of overfeeding and the Charybdis of tissue starvation.

Most victims of gout, especially of the acute form, are of the kind described as plethoric, but many of the chronic irregular type bear any underfeeding badly.

EXERCISE

The greatest amount of exercise consistent with the general condition of the patient is most important and desirable, but this must take into account the common cardiovascular complications and the condition of the joints.

Each case is to be judged individually on the basis of a searching investigation of the most comprehensive kind. Walking, horseback riding, cycling, fencing, handball, and the like are admirably adapted to many patients, but absolutely or relatively unavailable for others.

It must be borne in mind that the individual patient may find that exposure to cold, bodily fatigue, joint strains, walking on stony or rough roads, overuse of certain joints, and the like serve as exciting causes for gouty outbreaks, and are to be sedulously guarded against.

The punching bag and certain routine gymnasium exercises are often of value in cases where crippling of the lower extremities excludes the group preceding.

In almost every chronic case systematic general massage and carefully regulated passive, active, or resisted movements are of great assistance, often, indeed, indispensable.

Rowing and canoe-paddling are often of great use and value as permitting an adequate but self-adjustable form of exercise which may involve the upper body only, or, in the case of rowing, be made to cover the entire body if a sliding seat is utilized.

HYDROTHERAPY AND HEALTH RESORTS

The use of hydrotherapeutic measures is fully described in other sections of this work. (See Vol. I, Section I, Chapter IV.)

The amount of testimony to their efficacy on the part of physicians and laymen alike is so great that the writer cannot but believe that much good may be wrought in individual cases. However, his own opinion, based upon individual clinical experience, may properly be expressed.

He believes that the chief value of a resort to spas is to be found in the rest, the temptation to indulge in pleasant recreative exercise (which, at the best-regulated resorts, is taken under the direction of the physician and made an integral part of the routine treatment), fresh air, an orderly life, and the restricted but scientifically regulated diet prescribed in those spas having a high-class medical staff or offering opportunities for consultation with a sensible modern physician.

Too often the patients visiting resorts are subjected to depleting courses of treatment, without scientific or even common-sense direction, and not infrequently undertake dangerous lines of procedure independently or under mistaken diagnoses, resulting from errors both of commission and omission.

In the experience of the writer, cases of aneurysm, of nephritis, with excessive arterial tension, chronic myocarditis, and valvular lesions of high grade, have returned from certain "so-called" health resorts much the worse for misapplied treatment in the form of hot baths, drastic purging, excessive and unregulated exercise, unintelligently applied massage, and gymnastics. Too often a superficial examination results in a diagnosis of "lithemia," "floating kidney," or some other diagnostic bugaboo wholly unrelated to the patient's chief ailment and real therapeutic needs.

The same things may be said in relation to chronic joint troubles associated with conditions of subnutrition.

No physician is justified in recommending any resort unless he is fully advised as to the character of the place and the quality of the physicians in whose hands his patients are to be placed.

THE TREATMENT OF ACUTE GOUT

The treatment of acute gout is almost purely symptomatic, but in most cases strikingly effective.

The first step to be taken relates to the protection of the affected joint from movement and pressure, and elevation of the limb.

A cradle or other device must be adopted if the patient be in bed, even the bed clothing must not press upon the affected joint, and the foot and ankle should be gently but thickly wrapped in cotton and flannel.

Cool compresses or, better still, evaporating lotions are often well borne

and afford relief, but in many cases such warmth as is obtained by the packing of the joint, locally reinforced, if necessary, by laying hot water bottles or bags near the limb, gives as much or more relief.

The use of compresses wet with a saturated solution of magnesium sulphate is said to be of extraordinary value in the relief of pain in this and other acute joint affections.

Unnecessary handling and fussing over the joint are to be avoided when possible, as they increase pain and intensify the already oversufficient nervous and psychic irritability of the patient.

The application of ointments is probably almost useless, though mentholated preparations, ichthyol ointment, and the like occasionally seem to give relief or are offered as a concession to the preconceived notions of the patient.

Massage and early movement of the joint have been suggested, but he who would undertake them must be brave indeed, even to foolhardiness.

Drugs.—*Colchicum* is still the sovereign remedy for acute gout. Its action we know little about, and, unlike its modern rival, atophan, it seems to exercise no effect upon uric acid excretion. Wine of colchicum, or the tincture, represent the preparations chiefly in use. The dose of either preparation is from eight to fifteen minims (0.5-1.0 gm.) every three hours during the height of the attack, and a half dose for several succeeding days. Colchicum or colchicum salicylate may also be used in doses of 1-65 of a grain (0.001 gm.). The well-known effects of colchicum in causing purging, gastric irritation, and cardiac depression demand attention, and the drug must be at once withdrawn or greatly reduced in dosage if such symptoms arise.

One of the most recent contributions to the drug treatment of gout is atophan (Nicolaier and Dohrn); Retzlaff, Gudzent, Klemperer, Umber, and others recommend it highly, both for prophylaxis and in the attack itself.

It is claimed that under its use even on purin-free diet the uric acid excretion by the urine is increased.

Klemperer reports the use of massive doses [6 gms. (90 grains) during two hours] as effective in jugulating certain ordinarily intractable acute seizures and asserts that the drug is more efficient and less liable to cause untoward symptoms than is colchicum. This clinician finds that, if uric acid be introduced intravenously, the tendency to low excretion in the gouty subject (20-50 per cent.) is overcome by atophan to such an extent as oftentimes to bring excretion to the normal basis (80-90 per cent.).

The daily dose is 2-3 gms. (30-45 grs.). Its disturbing effects, exerted chiefly upon the stomach, are said to be rarely encountered, and, according to Retzlaff, are easily avoided by the simultaneous exhibition of sodium bicarbonate.

From the testimony of Klemperer, who, however, warmly advocates its use, it would seem that atophan fails in about one-quarter of the cases.

Zutser, A. Franckel, and Klemperer highly recommend the drug in acute rheumatism as especially valuable when the salicylates are not well borne. The writer has had no personal experience with this remedy, but the amount and character of the testimony offered in its behalf seem to justify the use of the drug despite the disillusioning experiences of our therapeutic present and past.

It is usually necessary and advisable to combine colchicum with some preparation of opium at the beginning of an attack and the hypodermic use of morphin is often indicated.

It is both justifiable and wise to administer also either aspirin (0.5 gm., 7½ gr.), phenacetin (gr. 7, 0.5 gm.), or antipyrin (gr. 7½, 0.5 gm.), every two hours until pain is relieved.

One is thus employing two or more remedies, each capable of relieving pain in a disease where the distress is agonizing and distinctly harmful to the general condition of the patient.

The combination of the iodids with colchicum is an old and well-tried measure of especial value in the chronic or irregular joint manifestations and mild atypical seizures.

The bowels should be kept open with salines after a preliminary dose of calomel.

DRUG TREATMENT OF CHRONIC GOUT

The treatment of chronic gout resolves itself largely into dietetic and hygienic management, and year by year drugs play a lesser part.

Many drugs have been recommended because of their supposed power to prevent the retention of purin derivatives in the blood and tissues and the resulting divers manifestations associated with the stormy periods of excessive uric acid excretion.

Uricedin, piperazin, lysidin, lycetol, lithia salts, and other preparations are widely used, harmless and comforting to the patient yearning for a specific therapy, but of little value as compared with a proper dietary and regimen.

Most of the modern writers deny the value of alkalies and logically attribute the improvement often observed under their use to the fact that a relatively purin-free diet and an abundance of water are coincidentally employed. The same explanation even more accurately fits the case of the grape cure, and many other forms of treatment represented by the dominant or exclusive exhibition of a simple purin-free food or variously graduated and refined methods of starvation.

The value of the alkaline waters in gout is probably largely due to

the regular daily ingestion of considerable amounts of pure water reinforced, as it so often is, by restrictive dietetic orders and systematic exercise.

Urotropin has been used and recommended because of its supposed power to chemically combine with uric acid within the body.

Whether such a combination actually occurs in the tissues or takes place in the urine is not certain, but it has been shown that about one-fifth of the urinary uric acid content appears in the urine as diformaldehyd-uric-acid during the periods of urotropin administration.

The drug is administered in doses of $7\frac{1}{2}$ -15 grs. (0.5-1.0 gm.) t. i. d., until evidences of bladder irritation or gastric disturbance appear.

In conclusion it may be said that in acute gout, drugs still play the leading part.

That in chronic gout the estimate of their value is being constantly lowered by those very conditions created by modern scientific research which have so largely added to our knowledge of the disease itself and its dietetic and hygienic management.

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CHAPTER III

ARTHRITIS DEFORMANS AND SO-CALLED CHRONIC RHEUMATISM

CHARLES LYMAN GREENE

It is somewhat difficult to deal intelligently with a group of diseases concerning the nature of which we have little exact information, and in relation to which not only the etiology and classification but even the correct nomenclature rest upon debatable ground.

We seem to be justified in denying that true chronic rheumatism is a common disease and in holding that rheumatoid arthritis is entitled to be considered as worthy of a separate name and description, even though it leads us into devious ways and blind alleys.

We may also hold with Luff that it is not merely a local affection and wish that the name might be made to more clearly indicate its non-relationship to rheumatism proper.

The more common of the rheumatoid diseases are best considered together and the classification of Goldthwaite most readily lends itself to therapeutic consideration.

ATROPHIC ARTHRITIS

This condition represents the classical type of the deforming arthritis. It sometimes originates in an acute attack of febrile polyarthritis closely simulating or apparently identical with acute rheumatism, but lacks the complete and prompt recession of symptoms and response to salicylates characteristic of the latter disease.

Indeed, certain of these acute attacks resist wholly the almost specific antirheumatic action of the salicylates, and the acute attack subsides, only to be repeated from time to time, with but little disturbance in the intervals; in others the course is one of progressive joint inflammation and crippling deformity tending to the establishment of those extreme conditions which we recognize as characteristic of "arthritis deformans."

More frequently the disease is insidious in onset, comparatively painless, almost or quite afebrile, and the swelling of the joints lacks the

marked heat and redness of the acute inflammatory lesions of true rheumatism or gout.

It occurs most frequently in young adults and is far more common in women. In a series of 110 cases reported by T. McCrae 50 per cent. of the polyarticular cases (92 in all) appeared in persons under thirty-five years of age; and, among Garrod's 500 cases, 411 occurred in women. In Osler's series, on the other hand, over half occurred in men.

In the writer's experience two-thirds of the atrophic cases have occurred in women.

Any attempt to combine the atrophic and hypertrophic deforming arthritis vitiates all statistics at present available, and it is better for clinical purposes to consider the atrophic cases apart from the other forms.

The dominant feature in such cases is atrophy, first of joint structure, later of the muscles, skin, and periarticular structures.

It involves by preference the smaller joints of the hands, and, in the usual insidious progressive type, extends to the feet. It may affect even the vertebral and maxillary joints, and, by its tendency to remittent progression with atrophy, produces serious deformity and in many cases a pitiable condition of complete helplessness.

True bony ankylosis rarely occurs except in the vertebral column, and the pain, harassing rather than severe, is so nearly continuous as to make the disease one of the most painful of the chronic group.

Within the past few years evidences have multiplied which tend to strengthen the opinion that such cases are due to chronic infections, auto-intoxication, or both. As in the case of acute rheumatism, there is as yet no established specific causative organism, though Poynton and Payne, Chauffard, Guerich, Bannatyne, Langmead, Goadby, and others have adduced strong testimony of its microbic origin based upon systematic bacteriologic examinations combined with animal experimentation.

Gonorrhea, syphilis, influenza, acute rheumatism, bronchiectasis, and especially chronic infections of the tonsils, nasal sinuses, antrum of Highmore, jaws, and gums are frequently associated with the development of atrophic joint lesions.

In the disease as it occurs in children (Still's Disease), and in a majority of cases occurring in adults, enlargement of glands is manifest and points strongly to antecedent or persistent infection.

HYPERTROPHIC ARTHRITIS

This ailment is characterized by increased density of bone, thickening and hypertrophy of the cartilages, and the formation of nodes of the type originally described by Heberden. It differs strikingly from the atrophic arthritis, not alone in the X-ray picture and pathologic joint find-

ings, but also in the lesser degree of deformity and disability produced and the fact that such atrophy as is present is chiefly that of disuse.

The factors influencing its development are much the same as those observed in the atrophic form, but, according to the experience of the writer, it develops later in life and is especially common in middle-aged women.

INFECTIOUS OR TOXEMIC ARTHRITIS

This form is the one which most nearly corresponds to chronic rheumatism. It is distinctly inflammatory and periarticular in type. The patient is subject to monarticular, or more often polyarticular, exacerbations of a distinctly inflammatory nature, and it is oftentimes distinctly associated with antecedent or recurrent attacks of acute rheumatism or a history of chronic infection, especially of the nasopharyngeal tract, and may be mild and transitory or progressive and severe.

Many observers believe that the condition of the gastrointestinal tract is of cardinal importance and that autointoxication plays a prominent part in its occurrence.

There is no question in the writer's mind as to the rapid and complete disappearance of all symptoms or their distinct and permanent betterment in many cases following radical extirpation of diseased tonsils, the cure of sinus disease, the repair of diseased teeth and gums, and the establishment and maintenance of good nutrition and improved metabolism.

STATIC AILMENTS

These lesions, if superficially considered, are not infrequently confounded with and ascribed to the conditions just described or even attributed to gout in the presence of a suggestive family or personal history.

On the contrary, they represent lesions due to maladjustment, as has been clearly shown by Goldthwaite.

Such are the "dry knee joint," "flat foot," and the relaxed sacroiliac joints so often associated with sciatic pain.

In a recent article Goldthwaite has again referred to the frequency of hitherto obscure pains of the low-lumbar or sacral type manifested especially when the patient maintains the stooping or even the sitting posture for long periods.

He also classes as "static" the shoulder pains due to a long-sustained forward posture, and many of the cases of subdeltoid and coracoid bursitis.

Victims of these conditions are usually of the relaxed, slender-boned type, with visceral ptosis, loose costal belt, and other stigmata which led Berthold Stiller to describe them as suffering from Universal Congenital Asthenia.

STILL'S DISEASE

This is regarded by many as childhood's picture of arthritis deformans, and occurs usually before the second dentition.

It is definitely infectious in type, but its actual causative factor is still unknown.

In this form of arthritis the disease first appears in the knees or wrists rather than in the small joints of the hand, as in the arthritis deformans of adults.

Its onset is usually insidious, but may be decidedly acute.

The spleen is tumefied, the glands adjacent to the joints very markedly enlarged, and the affected joints fail to develop crepitation, grating, or osteophytic outgrowths. Nevertheless joint fixation is likely to be marked and muscular atrophy is usually extreme.

Girls are much more frequently affected than boys.

The little victims usually appear badly nourished and show arrested development.

It is not responsive to treatment, and constitutes one of the most cruel, intractable, and hopeless of clinical states.

SPONDYLITIS

There would seem to be no ground for making a separate group of these cases. The involvement of the vertebræ may constitute the dominant feature of certain cases, but the same condition occurs in association with widely distributed polyarthritis apart from the spinal column.

McCrae has called attention to the curious male preponderance in such cases in his series.

Of 22 cases, 20 occurred in the male. In 13 the spine alone was involved, and in the remaining 9 there were associated symptoms in other joints.

CHRONIC GOUTY ARTHRITIS

Chronic gouty arthritis closes the list, and has already been considered under its proper heading.

THERAPY

In all forms of chronic nongouty arthritis a source of chronic infection should be sought and, if possible, removed whenever and wherever found.

It must be remembered that in no one of them, save the static ail-

ments, has an absolutely noninfectious cause been positively determined.

In the case of gout we have reasonably clear testimony of its origin in faulty metabolism, yet the actual or specific agent remains unproven, and, in any event, the metabolic disturbance associated with chronic infections is sufficiently well established to justify our attention to these matters.

In connection with the atrophic, hypertrophic, and toxemic forms of arthritis the importance of chronic infections cannot well be doubted. In these, as in gout, the question of a proper attention to the gastrointestinal tract is self-evident.

HYGIENIC TREATMENT

Fresh air, sunshine, the choice of a residence and occupation minimizing exposure to sudden alternations of heat and cold, and the avoidance of chilling are factors of great importance.

Proper underclothing is most important and when possible moderate exercise must also be sought, but not at the expense of pain and joint swelling.

In both the atrophic and hypertrophic forms the maximum of rest must be obtained, though careful passive and active movements should be attempted, kept always within safe limits. These are often best regulated by the patients themselves, who are easily taught to use them intelligently and are in a position to resort often to the necessary maneuvers.

DIET

In the writer's opinion, aside from the removal of any source of persisting infection or autointoxication and such surgical measures as are clearly indicated in appropriate cases, diet is the all-important matter.

Nearly all patients with nongouty chronic arthritis, and some even of these, are benefited by a generous or even forced diet, and this applies as well to the asthenic group who carry visceral ptoses and tend to establish aches, pains, or actual joint lesions of the static type.

Most of these arthritic patients suffer from the effects of self-starvation and a vicious tendency to eliminate one valuable and necessary food after another at the suggestion of well-meaning friends or because of the too prevalent ideas concerning the necessity for restricted diet still entertained by many conscientious physicians.

It is surprising to see the good effects wrought in many apparently hopeless cases of the atrophic type by a dietary rich in rare beef, chicken, game, fresh fish, oysters, good milk, or, better still, lactone, cream, butter, eggs, bacon, a sufficient but not excessive amount of sugar, good whole-wheat bread, rice, cereals, and the like. Six feedings daily should be taken, and when possible such a diet should be reinforced by rest in bed, general massage of the muscles, and when possible gentle but persistent

and oft-repeated passive or even active movements of the affected joints, strictly limited by the effect produced in relation to pain and swelling.

Certain cases of the hypertrophic variety may demand a more limited diet, but, in general, betterment of the nutrition is the cardinal factor in nongouty joint disease of the chronic type.

HYDROTHERAPY

The first principle should be clearly and emphatically stated.

Cases of atrophic arthritis and most of those representing the other nongouty joint affections are injured rather than benefited by depleting treatment.

The radical procedure represented by the methods in use at so many spas and sanatoria are useful and valuable in the gouty and plethoric, and possibly in lingering lesions following acute rheumatism, which latter, however, usually recover in any event under other treatment, or without it, and indicate, when persistent, the continued existence of a focal infection.

Such treatment is, however, distinctly harmful in most of the other joint infections, and especially so in the group classified under the head of atrophic arthritis.

The writer's experience has taught him that only in asthenic gouty individuals have the benefits of depleting treatment been evident.

In a few of the hypertrophic and toxemic cases the free exhibition of alkaline purgative waters, a restricted dietary, and a change of air and environment give good results, but these results are, as a rule, but temporary. Change of air, scene, and environment without a course of baths is usually equally or even more strikingly effective.

Lenhartz warmly advocated the use of local warm salt baths (4 per cent.) of from ten to twenty minutes' duration, followed by careful drying and gentle painless friction in a warm room.

Local mustard baths or the direct application of counterirritants, liniments, tincture of iodine penciling, and the like, are oftentimes comforting to the patient.

Temporary immobilization by splints will sometimes give those victims a comfortable night, but the prolonged application of fixation apparatus is distinctly contraindicated.

In some cases much good is accomplished by moderate compression. In others Bier's method affords marked relief (see Gonorrheal Arthritis), and even joint puncture has been warmly recommended.

Massage of the joints is often of value in skilled hands and under the physician's orders and direction. It is most effective when following the use of warm compresses or baths.

With respect to baths one may say that they are employed in many and divers forms.

The Warm Bath.—The simple warm bath of ten to forty-five minutes' duration and the warm salt bath are comforting and in many cases desirable.

The Permanent Bath.—The permanent bath at body temperature is often employed for thirty or even sixty days, and, while the effects are said to be good, the greatest care must be taken in gradually accustoming the patient to life outside of it. In fact, a subsequent carefully conducted hardening process is absolutely necessary and involves the services of an expert.

[v. Hebra, who first introduced the permanent bath, always permitted his patients to go directly from the bath into the courtyards of the hospital. He claimed that bad results never followed.—Editor.]

The Electric Light Bath.—The electric light bath is widely employed in institutions and is doubtless comforting, though not without danger to patients who carry a weak heart.

The Turkish Bath.—The same dangers arise in connection with the Turkish bath, which is to be recommended with considerable reserve, nor should any baths involving the use of extreme heat, whether moist or dry, be taken more than twice or thrice weekly.

Other Baths.—It would be useless to run through the entire list of mud, sulphur, hot, cold, moist and dry chamber baths, Scotch douches, and other hydrotherapeutic procedures at present warmly recommended by many physicians and firmly believed in by arthritics.

Nearly all give relief to pain for the time being, and doubtless help to promote absorption of exudates.

On the other hand, arthritic patients, and especially those suffering from larval or persisting rheumatism, often develop acute or subacute attacks during active hydrotherapy and, in the writer's experience, any good effects produced have been too often succeeded by a prompt reaccession of symptoms in cases of progressive chronic joint affections of the atrophic, hypertrophic, and toxic types.

DRUGS

The internal use of drugs in connection with chronic joint affections is almost wholly symptomatic.

In distinctly rheumatic cases or those definitely connected with a chronic infection the salicylates and their congeners are of moderate value. X-ray treatment and radium emanation have been employed but as yet have secured no wide acceptance.

The thyroid preparations in small doses and thymus have also been employed, but are not as yet established remedies.

Faradism, galvanism, and high frequency treatments are highly esteemed by many, and the former undoubtedly accomplish much in the way of retarding muscular atrophy.

In the other varieties sodium iodid is much used and at times seems of great value.

Luff has recommended guaiacol carbonate in atrophic arthritis and good results have been reported, more especially in cases showing acute or subacute exacerbations.

Luff writes enthusiastically of its benefits in the chronic progressive stage also and states that it should be employed for at least one year.

SURGICAL TREATMENT

It should be stated that many cases of chronic disabling and deforming joint diseases are treated surgically and that many are benefited by the application of proper apparatus with or without a preceding operation.

Locke and Osgood fully discuss this matter in a recent paper. They adopt and recommend radical operation to relieve the so-called villous form of arthritis after other measures fail.

In certain cases of disabling atrophic arthritis they attempt to secure the correction of extreme deformities by means of forcible manipulation and the use of fixation apparatus.

For infectious arthritis they use forcible manipulation or even *brise-ment forcé* in cases where the use of the X-ray shows unimpaired joint surfaces, but avoid any prolonged periods of fixation.

In the hypertrophic form they avoid surgical measures beyond the use of procedures adapted to secure rest for the joint and consequent relief of pain.

In closing, the writer would reassert his belief that the essential factors in the treatment of chronic non-gouty arthritis are:

- a. The removal of any recognizable source of infection.
- b. The improvement of body nutrition, by rest, hygiene, and a liberal dietary.
- c. Due attention to the possibility of autointoxication.

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CHAPTER IV

DIABETES MELLITUS

DAVID RIESMAN

Diabetes was known to the ancients as a disease characterized by thirst, excessive urine, and wasting of the flesh. Aretæus the Cappadocian (1) gives a remarkable description of it in the following words: "The nature of the disease, then, is chronic, and it takes a long period to form; but the patient is short-lived, if the constitution of the disease be completely established; for the melting is rapid; the death speedy. Moreover, life is disgusting and painful; thirst unquenchable; excessive drinking, which, however, is disproportionate to the larger quantity of urine, for more urine is passed; and one cannot stop them either from drinking or making water. Or, if for a time they abstain from drinking, their mouth becomes parched and their body dry; the viscera seem as if scorched up; they are affected with nausea, restlessness, and a burning thirst; and at no distant term they expire" (1). He derives the word diabetes from *διαβήτης*, a siphon, an etymology not accepted by all authorities. The credit for having discovered the sweet character of the urine belongs to the English physician, Thomas Willis, who says (80): "The statements of many authors, that the liquid imbibed is excreted little, if at all, changed, is very far from the truth; for in every case which I have met, and I believe that this holds true for all cases, the urine has differed greatly from the imbibed fluids, as also from any humor which is wont to be generated in our bodies, in that it is remarkably sweet, like a solution of honey or sugar." (Quoted by A. E. Garrod, 21.) A hundred years later Matthew Dobson (12) and the apothecary Poole isolated the sugar from diabetic urine, Dobson at the same time showing that such urine undergoes a vinous and acetic fermentation. Finding that the blood serum of the diabetic patient tasted sweet he concluded that the sugar in the urine came from the blood and was not made by the kidneys. This shrewd surmise stamps him as the discoverer of hyperglycemia. Chevreul in 1807 determined the sugar to be glucose or dextrose. John Rollo (66) was the first to lay down the principles of dietetic treatment. Since then history has been made so fast that it is useless in this article

to go into details. Many facts will be brought out later. Those who are especially interested may consult the works of von Noorden (60), Naunyn (58), Lépine (35), and other standard works.

Frequency.—Diabetes seems to be increasing in frequency. This is shown by the gradual rise in the death rate from the disease and by the greater frequency with which it is met in practice. Being, however, an unreportable affection there are no accurate data at hand as to the actual incidence. In the following table (Bulletin No. 109, Department of Commerce and Labor, Bureau of the Census) are given the total mortality from diabetes and the death rate per 100,000 inhabitants in the registration area of the United States during the years 1906-1910:

	Total Mortality	Death Rate per 100,000 Inhabitants
1906.....	5,331.....	12.7
1907.....	5,801.....	13.5
1908.....	6,274.....	13.4
1909.....	7,024.....	13.8
1910.....	8,040.....	14.9

A similar increase in the mortality is noticeable in other countries, and especially in the large cities. Le Goff (34) gives the following table of deaths from diabetes in Paris per 10,000 inhabitants:

1880.....	0.644	1895.....	1.525
1881.....	0.683	1896.....	1.504
1882.....	0.737	1897.....	1.596
1883.....	0.607	1898.....	1.580
1884.....	0.924	1899.....	1.526
1885.....	1.165	1900.....	1.700
1886.....	1.150	1901.....	1.481
1887.....	1.291	1902.....	1.462
1888.....	1.309	1903.....	1.511
1889.....	1.375	1904.....	1.601
1890.....	1.345	1905.....	1.665
1891.....	1.291	1906.....	1.760
1892.....	1.241	1907.....	1.785
1893.....	1.439	1908.....	1.704
1894.....	1.245	1909.....	1.930

It cannot be maintained that the increase in mortality is due to greater accuracy in diagnosis, for the urinary tests upon which the diagnosis is based have not materially changed in the last twenty or thirty years. Some writers attribute the increase to the fact that the number of persons lead-

ing a sedentary life has greatly augmented and that such a mode of life is a predisposing cause of diabetes. There has also been within the last few decades a great increase in the consumption of sugar. Governmental statistics show that in the United States in 1822 (the first year of which there is any record) the demand per capita was only 9 pounds—which had increased to 65 pounds in 1900 and to 76 pounds in 1906.

Diabetes is largely but not exclusively a disease of the well-to-do, who eat a great deal and at the same time do not take much physical exercise. It is, however, found among the poor, and is not rare in this country in the negro race. In Paris, as the statistics of Le Goff (*loc. cit.*) show, it is especially prevalent among lawyers, officials, professors, and physicians, a circumstance that seems to substantiate the dictum of Montequieu (53) "*Le souper tue la moitié de Paris, le diner l'autre.*"

The Jewish race shows a special liability to diabetes. Thus von Noorden (*loc. cit.*) found the deaths from diabetes to constitute among the Jews 1.9 per cent. of the total deaths in Frankfort, and among non-Jews 0.29 per cent. In this country, as far as my personal experience is concerned, the difference in the liability of Jews and non-Jews is not as great as it seems to be in Germany, Austria, and Hungary.

Diabetes occurs in all ages and in both sexes. Under the age of ten the two sexes suffer with nearly equal frequency. Later in life the disease is much more common in the male sex. No age is exempt—diabetes has occurred in infants under one year, and is not rare in early childhood. After the age of twenty-five years it increases in frequency.

Heredity plays a very large part in diabetes, and is traceable in at least 20 per cent. of all cases. The disease may occur in several members of the same family and it often, in a given family, has association with obesity and gout. The occurrence of conjugal diabetes, the alleged development of diabetes among laundresses who happen to have washed the clothing of diabetics, and a few similar facts have led some writers to consider diabetes an infectious disease. Hutinel (28) has collected nearly all the cases bearing upon this point. The infection is supposed to enter through the alimentary canal and to pass up the duct of Wirsung, causing an ascending pancreatitis. I myself have at present under observation two cases of diabetes in one family, a young girl of nineteen and her brother of twenty-one. But neither such facts nor those quoted by Hutinel are sufficient to prove the infectious nature of diabetes.

Pathogenesis.—Despite intensive work at the bedside and in the laboratory the pathogenesis of diabetes remains the same exasperating riddle it was when Dobson and Poole first isolated sugar from the urine. The essential feature of the disease is a disturbance in the carbohydrate metabolism as a result of which an excessive amount of sugar accumulates in the blood. The factors bringing about this disturbance are not definitely known. When von Mering and Minkowsky (49) published the results of

their brilliant discovery it was believed that the riddle of diabetes had been solved. These two observers found that complete extirpation of the pancreas in dogs was invariably followed by diabetes. They drew the conclusion that the pancreas supplied an internal secretion essential to carbohydrate metabolism. Other observers, while not denying the results of pancreatectomy, attributed them to interference with the nervous mechanism, an objection that was soon decisively answered. If the pancreas is excised and a piece transplanted under the skin diabetes does not occur, despite the fact that the nerves about the pancreas suffer the same trauma (Murphy, Pratt, and Spooner, 57). A similarly conclusive experiment was performed by MacCallum (43). MacCallum tied off a part of the pancreas from the rest and allowed it to undergo atrophy for a year. At this time the remainder of the pancreas was extirpated, and after a transient glycosuria the dog recovered completely. A subsequent extirpation of the film of tissue representing the atrophied part of the pancreas which had been left behind caused a most intense and persistent glycosuria. Extirpation of the pancreas is followed by the disappearance of glycogen from the liver and muscles. Support to the pancreatic theory of diabetes was given by the observations of Opie (63), Weichselbaum (79), Cecil (8), and others that the organ most commonly diseased in diabetes is the pancreas. A variety of changes has been discovered, but whatever they are they seem to affect most frequently the islands of Langerhans. Many have therefore concluded that the islands are the source of an internal secretion necessary to the carbohydrate metabolism, the absence of the secretion giving rise to the diabetic process. The recently published researches of Lindsay and Peters (37) seem, however, to throw doubt upon the specific importance of these structures and render it probable that the acini themselves manufacture whatever internal secretion the pancreas may possess. Cohnheim (10) has shown that sugar cannot be broken up by pancreatic extract alone nor by muscle substance alone, but when muscle juice and pancreatic extract are together allowed to act on sugar solutions the sugar is decomposed. As heat destroys the activity of the muscle extract, but not that of the pancreas, Cohnheim concludes that the muscles contain a glycolytic ferment which requires something from the pancreas for its activation. A number of other experimenters have not been able to confirm these observations.

For a long time the exclusively pancreatic theory of diabetes held sway. Gradually, however, evidence has been accumulated which shows that other organs besides the pancreas exert an influence on carbohydrate metabolism. It was found, for example, that glycosuria can be produced by injections of adrenalin and that this glycosuria, just like that of spontaneous diabetes, is associated with hyperglycemia. The thyroid gland and the hypophysis, and even the parathyroids, were found to have some connec-

tion with the carbohydrate metabolism. While the details of the complicated relationship of these various glands of internal secretion to the metabolism of sugar have not all been worked out, the experimental data at hand warrant the following tentative propositions: The liver and the muscles are the great storehouses of carbohydrate material in the form of glycogen. The pancreas through its internal secretion stimulates and controls the storing or warehousing of the hepatic glycogen. The suprarenal secretion has the function of liberating glycogen in response to the needs of the system, thus acting in an opposite way from the pancreas. The thyroid gland seems to possess an inhibitory influence upon the pancreas, lessening the control of the latter over the glycogen retention in the liver. This explains why in hyperthyroidism, e. g., exophthalmic goiter,

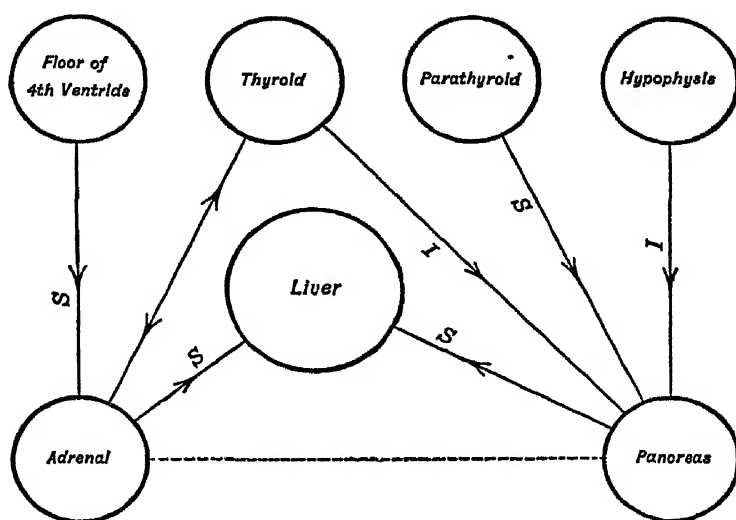


FIG. 1.—SCHEME ILLUSTRATING THE RELATION OF THE LIVER AND PANCREAS TO THE DUCTLESS GLANDS AND THE NERVOUS SYSTEM WITH REFERENCE TO THE CARBOHYDRATE METABOLISM

glycosuria frequently occurs and why it is easily produced by the ingestion of large amounts of glucose (alimentary glycosuria). The hypophysis seems to act like the thyroid; in other words, it sends inhibitory impulses to the pancreas. The parathyroids, on the other hand, have an action opposite to that of the thyroid, an alimentary glycosuria being produced more easily after their extirpation than when they are present (MacCallum, 44). The diagram in Figure 1 illustrates in a schematic way the relations just described.

It is evident that the interlocking relationship of so many organs of carbohydrate metabolism must needs have some superior control. This, it is now definitely proved, is exercised by the sympathetic nervous system. The impulses pass from the floor of the fourth ventricle over the sympathetic to the left adrenal and thence through the splanchnic to the liver. If the splanchnic nerve is cut, or if the suprarenals are extir-

pated, puncture of the floor of the fourth ventricle (*pigûre*) is powerless to produce glycosuria.

From what has been said above we may conclude that diabetes is a metabolic disease dependent upon a fault in some one of the internal secretions. At the present time we are unable to distinguish clinical types corresponding to the various disturbances possible in the chain of diabetogenic organs, but it is *a priori* probable that the known differences in the types of the disease may thus eventually find their explanation and that the symptom-complex that we now call diabetes will be subdivided according to the site of functional trouble.

The Hyperglycemia of Diabetes.—As has been stated in the preceding section, disturbance in the carbohydrate metabolism leads to the accumulation of sugar in the blood, to hyperglycemia. Normally sugar is present in the blood to the amount of 0.05 to 0.12 per cent. In diabetes the amounts vary from 0.16 to 1.16 per cent. The kidneys are able to hold back sugar when it is present in normal quantity, but when the sugar concentration is increased the kidneys no longer are able to keep the sugar from passing out into the urine. The presence of sugar in the urine, the glycosuria, in diabetes is thus the expression of a state of hyperglycemia—it represents, as it were, an overflow.

While the glycosuria is thus easily explained, the hyperglycemia is much more baffling. Why does sugar accumulate in the blood? Two theories suggest themselves: one, that the diabetic cannot oxidize sugar; the other, that too much sugar is made. The first seems very simple and is held by many writers, but there are a number of weighty objections to it. In the first place, the diabetic has not lost the power of oxidizing chemical substances. He can oxidize glycuronic acid, saccharic acid, and mucic acid; all three probably intermediary products of sugar catabolism. His apparent inability to perform the initial step in the breakdown of sugar is attributed by a number of writers to the absence of a certain glycolytic ferment. Calorimeter experiments seem, however, to show (Porges and Salomon) that the diabetic is capable of burning sugar.

The other theory, that the fault is not so much an inability of the diabetic organism to consume sugar as it is an excessive formation, is the one at present held by some of the best students of diabetes. It is the one that von Noorden, who for years held the former, has now adopted. It is based on the theory that with disease of the pancreas the liver is given over to the stimulating action of the adrenals which causes the mobilization of the glycogen as soon as it is formed. In other words, the glucose formed in the intestines out of carbohydrates of all kinds and in the liver converted into glycogen, is immediately reconverted into glucose and poured into the blood in quantities far beyond the needs of the system. In the accompanying diagrams are shown the normal sugar

metabolism and the two concepts of diabetes—that of non-use and that of excessive production, respectively.¹

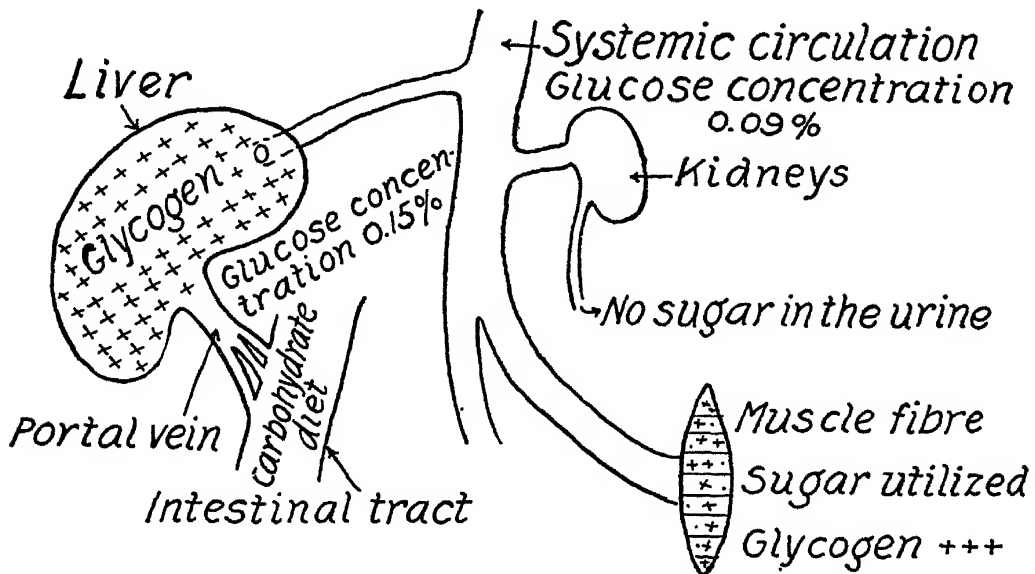


FIG. 2.—DIAGRAM ILLUSTRATING NORMAL SUGAR METABOLISM

Can diabetes occur in the absence of hyperglycemia? It is conceivable that the kidneys may become pervious to sugar when the latter is not

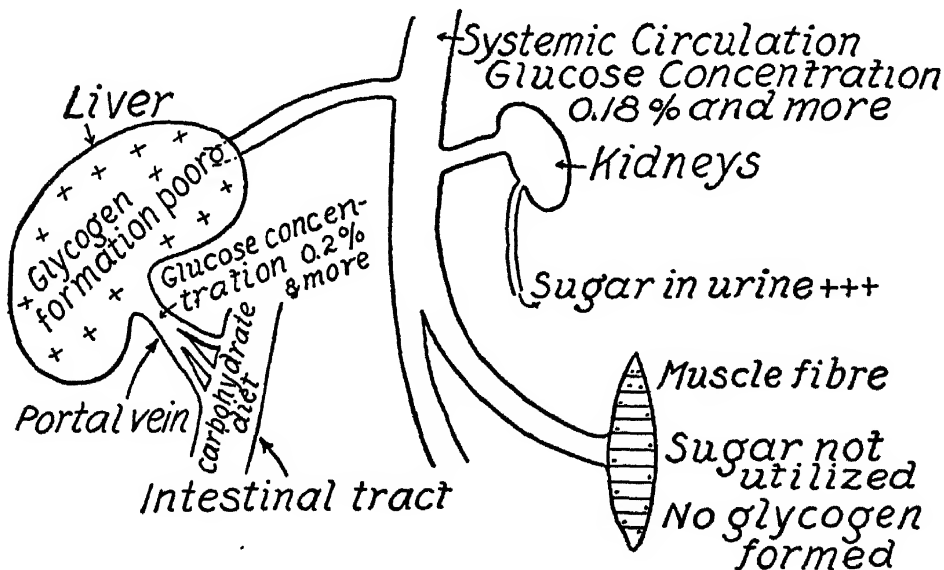


FIG. 3.—DIAGRAM ILLUSTRATING THE THEORY OF NONUTILIZATION OF SUGAR IN DIABETES

present in excess in the blood. A few such cases have been reported and have been spoken of as renal diabetes. They are distinguished from or-

¹ For these diagrams I am indebted to Dr. A. I. Ringer.

dinary diabetes by the absence of hyperglycemia. Experimentally a renal type of diabetes can be produced in lower animals by the injection of

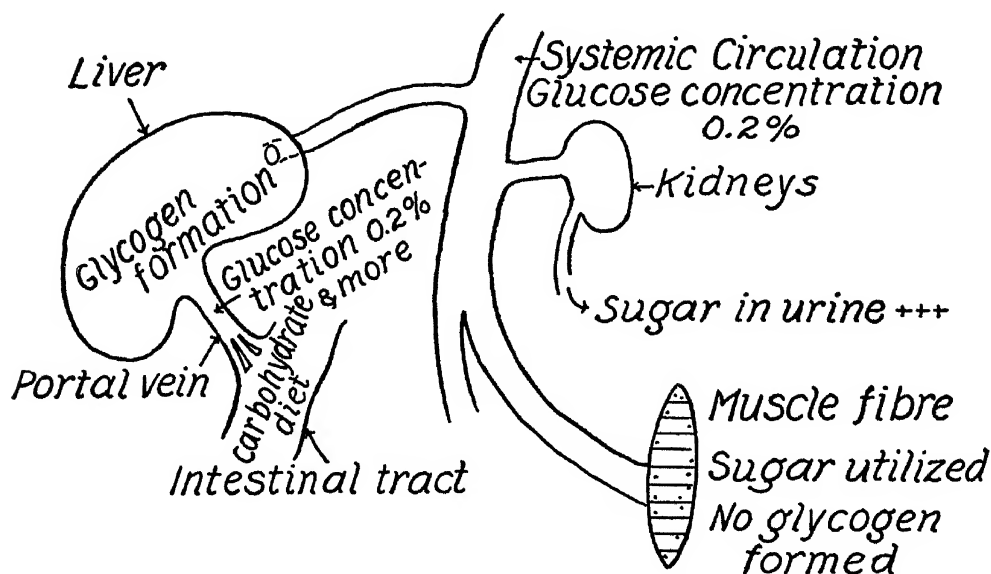


FIG. 4.—DIAGRAM ILLUSTRATING EXCESSIVE FORMATION OF SUGAR THROUGH NONRETENTION OF GLYCOGEN IN THE LIVER

phloridzin, a glucosid obtained from the roots of certain trees, as the apple and pear. When injected into an animal phloridzin causes a glycosuria which is temporary but can be renewed by repeated injections, the animal presenting symptoms characteristic of true diabetes. As the blood shows no hyperglycemia, but rather hypoglycemia, the glycosuria must have a cause different from that operative in diabetes. Phloridzin either affects the kidneys in such a way that they become more pervious to sugar or it breaks up the hypothetic colloid combination in which the sugar according to some authorities exists in the blood. There is no *a priori* reason why certain substances in man might not act like phloridzin in lower animals. According to the recent observations of Lindsay and Peters (*loc. cit.*) there is in phloridzin diabetes a slight hyperglycemia.

The Energy Requirements in Diabetes.—Under the same external conditions the diabetic requires the same number of calories as a healthy man, namely, 35 calories per kilogram of body weight at rest, equal to 2,300 to 2,400 calories per day, and 40 calories per kilogram at work, equal to 2,800 calories. As the diabetic does not consume the carbohydrates and loses their caloric equivalent, he has to obtain the calories lost by increased ingestion of protein and fat. A female patient of von Noorden's, for example, ingested per day:

Proteid	148 grams	606.8 calories
Fat	1,028 grams	948.6 calories
Carbohydrates	180 grams	738.0 calories
		<hr/>
		2,293.4 calories

At the same time she excreted in the urine 141 grams of sugar and thereby lost 578 calories, so that her food had a nutritive value of only 1,715 calories (2,293 minus 578). As the patient weighed 55 kilograms she needed 1,925 calories (55×35) per day, and as her food supplied her only with 1,715, there was a deficit of 210 calories that had to be made up by taking in proteid food and fat. Many patients lose much more carbohydrate in their urine. I have seen patients that excreted as much as 400 grams of glucose per day, or 1,600 calories. These facts explain why diabetic patients have such extraordinary appetites and ingest such large amounts of food. After the carbohydrates are deducted it is found, however, that the actual calories consumed are the same as those of normal individuals under the same conditions. In severe cases of diabetes, as has been shown by Benedict and Joslin (6), there is an increase in the metabolism of about 15 per cent. over that of normal persons. It is possible that disturbances caused by acidosis are responsible for this augmentation.

Sources of Sugar.—Normally sugar is derived from the carbohydrates, which make up a very large part of our food. They are taken in a variety of forms, chiefly as starch in vegetables, such as potato, in bread and other things made of flour; as sugar—cane-sugar, milk-sugar, glucose, levulose in fruits, and a few rarer sugars such as pentose; as dextrins, etc. No matter how introduced into the alimentary canal, before absorption they are transformed by diastatic ferments into glucose.

The great function of the carbohydrates is to yield energy and heat. One gram through combustion liberates 4.1 calories of heat. (One calorie is the amount of heat necessary to raise the temperature of one kilogram of water 1° C.)

In diabetes the sugar found in the blood and in the urine is primarily derived from carbohydrates as long as they are ingested. In cases in which, after exclusion of carbohydrates from the diet, the sugar disappears, we may infer that the carbohydrates were the only source of the sugar. In many cases of diabetes, however, sugar continues to be eliminated after the total exclusion of sugars and starches from the food. Hence there must be other sources than ingested carbohydrates. There are but two—proteids and fats.

SUGAR FROM PROTEIN.—That sugar may be formed from protein has been proved by many experiments. There are, indeed, some proteins that contain an actual carbohydrate radicle, chiefly glucosamin. Many of

the commoner proteins, however, contain little carbohydrate, and casein contains none at all, yet all of them may furnish sugar. The source of the sugar in these is the amino-acid moiety of the protein molecule. One hundred grams of protein are capable of furnishing about fifty-eight grams of glucose, and as the same amount of protein gives rise to sixteen grams of nitrogen, there is a definite ratio between the glucose and the nitrogen (D:N ratio) of 3.6. Of the many amino acids found in protein only certain ones, especially glycocoll, alanin, aspartic acid, and glutamic acid, are glucose producers; leucin, tyrosin, phenylalanin, and others are not.

SUGAR FROM FATS.—An historically and scientifically interesting dispute has been waged over the question whether sugar is formed from fats. That fat is formed from carbohydrates is a matter of common experience, but the converse is not fully established. An animal made diabetic by pancreatectomy receiving a protein-poor diet eliminates a definite amount of sugar, that is, definite when compared with the nitrogen elimination (D:N ratio). If fat is now added to the diet no increase in sugar elimination occurs, as may be seen from the following experiments by Huebner (48): A diabetic patient on being fed with 176 grams of albumin and 150 grams of fat eliminated 51 grams of sugar; on adding 169 grams of fat more he eliminated 50 grams. But as Magnus-Levy points out this is not an absolute proof of the non-formation of sugar from fat. The fat in this experiment might for the time being have been stored and thus have escaped the metabolizing process.

Fat is composed of glycerin and fatty acid. Glycerin is glycogenic, as the experiments of Külz and Lüthje (40) prove. As for the fatty acids, sugar might be formed from them by way of lactic acid. Chemically this is entirely compatible with known laws, but there is no definite proof as yet that it happens in diabetes. There are, however, grave cases of the disease in which the D:N ratio on a pure protein-fat diet is much higher than would be expected were the sugar derived solely from protein. In such cases it may come from the fats or fatty acids.

Transient Glycosuria.—Transient glycosuria, besides being caused by the diabetic tendency, may be due to injuries, especially cerebral injuries, to febrile infectious diseases, to certain poisons, as, for example, phosphorus, arsenic, uranium, carbon monoxid, amyl nitrite, chloral, chloroform, ether, bichlorid of mercury etc., to the ingestion at times of thyroid preparations, to grave asphyxia, and to the excessive intake of sugar. Regarding the last cause it has been found that there is a limit in practically all persons to the amount of sugar taken by the mouth that can be metabolized. If this limit is exceeded sugar will appear in the urine. Such a glycosuria is designated as *alimentary glycosuria*. There is, moreover, a personal variation among healthy individuals in their capacity for oxidizing sugar. Von Noorden gives the following table showing the

assimilation limit for various sugars. When amounts beyond this are ingested sugar appears in the urine:

Milk sugar.....	120	grams
Cane sugar.....	150-200	grams
Fruit sugar (levulose).....	120-150	grams
Glucose	150-180	grams
Galactose, about.....	20	grams

For starch assimilation there is in health no limit. This is probably due to the slow conversion of the starch into sugar which enables the system to deal with it in small amounts. Every one that excretes sugar after the intake of starch must therefore be looked upon as either potentially or actually diabetic. Alimentary glycosuria lasts from four to eight hours; from 1 to 20 per cent. of the ingested sugar may be eliminated.

General Characteristics of Diabetic Urine.—The characteristic and diagnostic feature of diabetes is the finding of sugar in the urine. This sugar is dextrose or glucose, a hexose or monosaccharid of the formula $C_6H_{12}O_6$. According to some authorities it is present even in normal urine, but in such minute traces—not over 0.05 per cent.—as to elude the ordinary clinical tests, the delicacy of which does not exceed 0.1 per cent. Glucose is a fermentable sugar and readily decomposes in urine through the activity of yeast cells with the evolution of CO_2 . It may happen, especially in warm weather, if but traces of sugar be present and the urine is allowed to stand for some time before being examined that all of it is fermented and no reaction to the ordinary tests is obtained. This is a source, though not a common one, of diagnostic error.

Another cause of error is the important fact that in many cases of diabetes, especially those of mild type, sugar is not present in every specimen of urine voided. It is therefore important to examine specimens from different parts of the day, or one of a measured twenty-four-hour collection. The latter is preferable for it enables us not only to detect the sugar qualitatively, but also to calculate the total amount of sugar excreted from the percentage of sugar in the specimen submitted for examination.

The diabetic urine is pale yellow; has a high specific gravity, 1,020 to 1,060; and is usually voided in very large amounts. Five liters (ten pints) are common and frequently double this quantity is reached. As a rule the specific gravity does not fall with the increase in the quantity of urine as is the case normally. The acidity of the urine is very marked, especially when the so-called acetone or ketone bodies are present. These bodies are beta-oxybutyric acid ($CH_3-CHOH-CH_2-COOH$), diacetic acid ($CH_3-CO-CH_2-COOH$), and acetone ($CH_3-CO-CH_3$). The other features of diabetic urine need not be discussed.

The sugar in the urine in diabetes and in most temporary glycosurias, as has been said, is glucose. Other sugars may be found. Reference has already been made to various alimentary glycosurias that may occur in otherwise healthy persons when too much of a particular sugar is ingested. The following sugars in addition to glucose may appear in the urine:

A. Milk-sugar or lactose, for which the assimilation limit seems to be about 120 grams. Lactosuria occurs after the ingestion of amounts beyond this quantity, and also spontaneously in nursing women about the third or fourth day of lactation. The amount causing lactosuria under such circumstances is naturally much smaller than that when the lactosuria is of alimentary origin. Lactose entering through the blood system, as it does in the case of puerperal lactosuria, cannot be utilized by the tissues. It can be oxidized only after it has been decomposed by the ferments of the alimentary canal into its constituents, glucose and galactose.

B. Saccharose or cane-sugar. The assimilation limit for this in health is large—from 150 to 200 grams. Saccharosuria is never found spontaneously in diabetes.

C. Levulose, fructose, or fruit sugar. This is found in the urine under several conditions:

- a. After excessive ingestion of it, as when inordinate quantities of sweet fruits are taken. The normal assimilation limit for levulose is from 120 to 150 grams.
- b. In diseases of the liver an alimentary levulosuria is at times easily produced by amounts below the normal assimilation limit.
- c. If diabetic urine is allowed to stand until it becomes alkaline some of the glucose may be converted into levulose.
- d. In severe cases of diabetes a spontaneous levulosuria may be not infrequently demonstrated by proper tests, the levulose being found in conjunction with glucose. Its presence indicates that the power of glycogenesis is at a very low level. It is not impossible, however, that the alkalies that are often given in such grave cases have something to do with the development of the levulosuria.

D. MALTose.—Maltose is rarely ingested. Its chief source is beer. Some persons excrete sugar after drinking beer, but whether this is glucose or maltose has not been definitely determined. A spontaneous maltosuria is said to occur at times in diabetes, but its significance is not known.

E. PENTose.—Pentose is a sugar containing five atoms of carbon. It gives the reduction tests for sugar—Nylander's and Trommer's, the lat-

ter taking place, however, only after cooling and somewhat interruptedly. The pentoses do not ferment, and as regards polarized light they show a variable behavior, some being inactive, some dextro-, some levorotatory. Three types of pentosuria may be recognized (S. Solis Cohen, 9):

1. Alimentary pentosuria, due to the ingestion of food rich in pentoses, such as huckleberries, cherries, plums, pears, and apples, many vegetables, and wines. Milk also contains traces of pentose.
2. Complicating or diabetic pentosuria, in which pentose and hexose are eliminated together.
3. Essential pentosuria in which the excretion of pentose is persistent, independent of diet, and not associated with diabetes mellitus.

The pentose appearing in alimentary pentosuria is dextrorotatory arabinose, while in essential pentosuria an inactive arabinose is excreted. Essential pentosuria does not seem to have any deleterious influence on the organism. Its chief interest lies in the fact that it may be confounded with diabetes and cause the patient to be denied the benefit of life insurance and perhaps to be subjected to useless antidiabetic treatment.

GLYCURONIC ACID.—Glycuronic acid is one of the intermediary products of glucose decomposition in the body. It is always found in combination with fatty or aromatic alcohols in the form of the so-called conjugate glycuronates. According to Meyer (50) and Meyer and Neuberg (51) an increased elimination of glycuronates precedes alimentary glycosuria and sometimes accompanies true diabetes. As the glycuronates have the power of reducing copper and bismuth in alkaline solutions their presence is likely to lead to an erroneous diagnosis of diabetes. They do not ferment. The acid itself is dextrorotatory, while the glycuronates turn polarized light to the left.

Prognosis.—Is diabetes curable? Many with the right to speak say it is not. A diabetic is cured if he can eat like other persons without a return of glycosuria. It must be admitted that such a result is not often attained. By far the greater number of patients with diabetes, if they succeed in ridding the urine of sugar, can keep it sugar-free only by a certain amount of dietetic restriction. I am, however, of the opinion that there has been too much pessimism regarding the curability of diabetes and even regarding recovery from acidosis and coma. Diabetes in the young is rightly very much feared and certainly the majority of cases end fatally after a comparatively short time. Yet, as the following case of Huerter (26) shows, cure is possible: The patient was a little girl of ten years with a diabetic history in the family, though not in the patient's. After several intestinal attacks she began to have typical signs of diabetes, with sugar up to 9 per cent. and traces of diacetic acid. Under dietetic treatment sugar disappeared and the child was able to consume 420 grams

white bread without excreting sugar, and 50 grams of glucose were also without effect.

I have under observation at the present time a young man of twenty-one and his sister of nineteen, the former having shown for the last eighteen months, and the latter for a year, sugar in the urine. Under a careful dietetic regimen the patients have gained weight and the sugar has been reduced to traces and in many specimens is entirely absent.

Many middle-aged and old persons with diabetes, especially if they are obese, never suffer much nor have life materially shortened by their malady. The prognosis is, however, not nearly so good if the patient is markedly arteriosclerotic.

It is probable that if cases are taken in hand early real cures may be achieved. The frequent examination of urine by the family physician, as well as the vigilance of life-insurance examiners, is sure to bring cases of diabetes under medical care much earlier than has happened in the past. This will make it possible to institute those methods of dietetic restriction by which the carbohydrate tolerance is preserved and perhaps eventually restored to the normal.

PROPHYLAXIS

As heredity plays an important though not an understood part in the propagation of diabetes—one-fifth of the cases are hereditary—it is advisable to undertake some prophylactic measures in families in which the diabetic taint exists. That such measures prevent diabetes is of course beyond the possibility of proof, for one can never say in a given individual that diabetes would have developed had certain measures not been taken. Children of diabetic families must be brought up on a dietary from which sugar and candy and cakes are to a large extent excluded. If there is a tendency in the family to obesity, with or without diabetes, the life of the growing generation should be so shaped that by exercise and a rational dietary—not too much food nor too rich food—adiposity is avoided. Physicians have not hitherto entered into this field of preventive medicine with sufficient interest and purposiveness, but by taking a larger view of their function in this direction they may accomplish much in the prevention of diseases of metabolism.

Persons who, under stress and strain, or after injuries, have shown transitory glycosuria should naturally adopt a diet calculated to conserve and strengthen their carbohydrate tolerance. That is, they should limit their intake of sugars and starches. A life free from undue excitement is also important.

Prophylaxis becomes imperative in persons who have had pancreatic

disease. If they have lost, either through operation or through spontaneous necrosis, part of their pancreas, they are in danger of diabetes. A proper antidiabetic regimen should be early prescribed and starches should be allowed only under constant control of the carbohydrate tolerance. Even the protein intake must be lessened. Whether the administration of fresh pancreas, as Pratt found in dogs, or pancreatic extract has a prophylactic value remains to be investigated. With a diminishing tolerance I should feel that the use of fresh pancreas were worthy of a trial.

A measure of prophylaxis of the greatest importance and the widest applicability is frequent urine examinations. They are especially valuable in the children of diabetics and in those who have had traces of sugar. In the obese and in children of the obese and diabetic and in those with a history of previous pancreatic disease, and in all with temporary glycosuria, the urine ought to be examined at least four times a year. I am in the habit, in patients belonging to these various groups, of instituting from time to time the test for alimentary glycosuria. This test is performed as follows:

The patient provides himself with a half dozen specimen bottles bearing blank labels. On rising in the morning he takes 100 grams of glucose and immediately voids urine into one of the bottles. Thereafter he empties his bladder every two hours, using the specimen bottles and noting the time on the label. All the bottles are then brought for examination and the urine tested qualitatively for sugar. In a normal person the glucose is all burned up and none appears in the urine.

Diabetic Acidosis and Diabetic Coma.—Acidosis, the underlying cause of diabetic coma, arises in healthy as well as in diabetic persons whenever the carbohydrates are excluded from the diet. In diabetes it may occur in those who are taking carbohydrates, for the simple reason that for all practical purposes the carbohydrates are not in the diet at all, as they are not utilized. Acidosis is due to an autointoxication with certain lower fatty acids, of which the most important is beta-oxybutyric acid. The appearance of this is usually associated with the presence in the urine of diacetic acid and acetone, of which it is the mother substance. All three are sometimes spoken of as the acetone or ketone bodies and their presence in the blood as acetonemia and in the urine as acetonuria or ketonuria.

Beta-oxybutyric acid is formed in the metabolism of the fats, being in all probability a normal intermediary product; but so quickly is it oxidized in health that no accumulation of it takes place. In diabetes this oxidation may fail to occur, apparently because of the non-combustion of carbohydrates. The beta-oxybutyric acid accumulates in the blood in large amounts and, together with its derivatives, acetone and diacetic acid, is eliminated in the urine. Acetone is also eliminated in the breath.

As much as 160 grams of acetone have been excreted in a day in diabetic acidosis (Magnus-Levy, 47).

Some persons seem to bear acidosis better than others, and there are cases in which for weeks and months as much as 40 or 50 grams have been excreted per day without apparent deleterious consequences.

Much has been written on the subject of how the acetone bodies cause coma. The view most generally held is that they rob the body of alkalies and thus lessen the alkalinity of the blood and tissues. For a time the system tries to protect itself against this dealkalinization by forming ammonia in large amounts to neutralize the acids. The ammonia can be found in the urine and its estimation is one of the most valuable tests of the degree of acidosis. Some recent experiments seem to show, however, that beta-oxybutyric acid is a specific poison quite independently of its acid character, for it acts in the same way in animals whether given as acid or as sodium butyrate.

Diabetic coma is the most serious complication occurring in diabetes. It is the cause of death in from 30 to 50 per cent. of all cases. Frerichs, among 400 cases of diabetes, had 250 deaths, 151 from coma. Von Noorden, among 1,853 cases, had 292 deaths, among them 169 from coma, a percentage of 57.8.

Diabetic coma may occur without warning, being precipitated by nervous shock, by injury, by surgical operations under anesthesia, by an acute attack of indigestion or gastroenteritis, and by alcoholic excesses. Diabetic gangrene and acute infectious diseases may cause a latent acidosis to pass into coma. In one of my patients, a woman of seventy, who had had diabetes for many years, an influenzal bronchitis led to a fatal attack of coma.

In many instances the coma is preceded by premonitory symptoms: restlessness; abdominal pain, especially in the appendix region (the latter may be so severe that appendicitis is suspected); shortness of breath; irritability, staggering, dizziness, sudden intense thirst, yawning, pain in the limbs, headache, and drowsiness. In every case of coma of unknown cause a diabetic origin should be suspected and the proper urinary tests made. It should, however, be remembered that not every attack of coma in a diabetic is necessarily due to acidosis. It may be due to uremia, to apoplexy, or to obstruction of an arteriosclerotic vessel in the brain. A fruity, aromatic, or chloroformlike odor on the breath is suggestive, even more so is very deep breathing (Kussmaul's breathing), but the most valuable sign is the discovery of sugar and diacetic acid in the urine.

Tests for the Acetone Bodies; Qualitative Tests.—**DIACETIC ACID.**—*Gerhardt's Test.*—Add to the urine a few drops of a strong solution of ferric chlorid. If a precipitate forms it consists of the phosphates of iron, and more ferric chlorid should be added. If diacetic acid is present a Bordeaux-red color appears. In performing this test it must be borne in

mind that if the patient is taking salicylic acid or antipyrin a similar color will develop when chlorid of iron is added.

To avoid the disturbing action of the phosphates in making Gerhard's test von Noorden recommends the following modification: 10 c. c. of a 6 per cent. solution of ferric chlorid are placed in a small beaker and the urine added, drop by drop. Even when phosphates are present in large amounts they will not disturb the reaction. The degree of intensity of the reaction is not a reliable guide to the amount of diacetic acid present.

To distinguish between diacetic acid and other oxy-acids giving the same reaction with ferric chlorid the urine should be boiled. Boiling decomposes the diacetic acid, while salicylic acid and similar compounds are not changed, and the urine continues to give the ferric chlorid reaction after boiling.

Ondrejovich's Test (62).—To 10 c. c. of urine acidulated with a few drops of acetic acid add 5 drops of Lugol's solution and shake with 2 c. c. chloroform. If diacetic acid is present the chloroform remains colorless, otherwise it assumes a rose color due to the dissolved free iodine. The advantages of this reaction are that it is quickly done, that it is not given by salicylic acid preparations or by antipyrin; that it does not cause a precipitation of the phosphates, and that it is very delicate. It may be used for quantitative tests; these I shall not describe in detail, but refer those interested to the original article.

ACETONE.—*Lugol's Test.*—Add to the urine a few drops of a fresh solution of sodium nitroprussid and render alkaline with sodium or potassium hydrate. A beautiful purple color develops, and if the urine is now overlaid with ammonia a purple ring will appear at the junction of the two fluids.

Lieben's Test.—The urine is alkalized with sodium or potassium hydrate and a few drops of Lugol's solution added. If acetone is present the odor of iodoform becomes apparent and eventually crystals of iodoform are thrown down. It is better to perform this test with the distillate of the urine.

BETA-OXYBUTYRIC ACID.—The urine should be fermented so as to remove the dextrorotatory glucose. If the urine after fermentation turns polarized light to the left beta-oxybutyric acid is in all probability present.

The foregoing part has been made somewhat fuller than is customary in text-books on therapeutics. This is due to the fact that the treatment of diabetes can be carried out intelligently only if something of the nature of the disease is known—if the chemical and physiological principles underlying the diabetic process are understood.

TREATMENT**GENERAL PRINCIPLES**

The ideal of treatment of any disease is the removal of the cause. In diabetes this is not possible for the cause is unknown. We must therefore be content to work for the removal of the principal symptom—the glycosuria, the lessening or abolishing of which means the lessening or abolishing of the hyperglycemia, the main factor responsible for the symptoms of the disease. This object—the removal of the sugar from the urine—can be accomplished only by a proper dietetic regimen. Drugs alone are powerless to do it. The diet must be so adjusted to the impaired metabolism as to render the urine sugar-free without injuring the general health of the patient.

Diabetes cannot be treated in a schematic or routine manner. The cases differ and must be treated individually. The patient must be informed of the importance of diet in the treatment, and it must be made plain to him that his salvation is altogether in his own hands; that occasional sugar or bread orgies hurt him and no one else; that he cannot undo the harm of a lapse from dietetic virtue by subsequent strict asceticism; that such indulgences may overtax his tolerance permanently and put it a peg lower. In no disease is the patient to be warned more against quackery and quack remedies, for the harm of improper treatment cannot be well retrieved. He should be told once for all that there is no drug that will cure diabetes and that most of the bread substitutes and other diabetic foods contain an amount of starch that is not negligible.

Many physicians are inclined to be lax, and as long as the amount of sugar eliminated is small to permit the patient to be rather liberal in his diet. By some this is done with a desire to keep the patient ignorant of the real nature of his malady; by others from a lack of interest or firmness or knowledge of the disease. This attitude, whatever the motive, is unjust to the patient. Bad results may not follow at once, but they are sure to come. Diabetes is a disease against which the plan of battle must be laid not for a month or a year, but for a decade, indeed for a lifetime. To tell a patient that he must live on such and such a diet and then let him shift for himself is not fulfilling our duty. The fact must be brought home to him that if he wants to keep the disease under control he must be vigilant for all his days. It is of course essential before the patient is told he has diabetes that his case be studied so thoroughly that the conclusion is unequivocal. The various dire complications that may occur in the course of diabetes need not be foretold—nothing is to be gained by alarming the patient, unless he will not obey instructions, in which event it is usually justifiable to scare him into good behavior. It

is in this way that some of the diabetic foods and vaunted remedies achieve good results: A patient who persists in disregarding the physician's gentle advice will often carry out conscientiously the very strict dietetic instructions printed in the minatory literature accompanying proprietary articles. For the improvement that follows he will give credit to the remedy and not where it belongs—to care in diet.

If sugar is discovered in the urine of a patient his case should be conducted in the following way: It should first be determined whether sugar is constantly present or whether the case is one of transient glycosuria. This can readily be done by examining a night and a morning specimen or, preferably, a specimen of the twenty-four-hour collection, for several successive days, while the patient is on his ordinary diet. If sugar is found repeatedly, even though it is not present in every specimen, the case may be looked upon as one of diabetes. Should the first examination have shown in addition to large amounts of sugar the presence of diacetic acid it may be wiser instead of taking several days for studying the case to place the patient at once upon treatment for acidosis, which is described on another page.

Having determined that the patient has diabetes the next step is to find out to what type of diabetes his case belongs. Is it mild, moderately severe, severe, or grave? It is *mild* if glucose disappears from the urine as soon as the carbohydrates are eliminated from the diet and does not reappear when a small amount of carbohydrate food, such as 100 grams of bread, is added to the dietary. It is *moderately severe* if the sugar disappears on restriction of the diet but reappears when carbohydrate, even in minimal amounts, is added. Such a patient has no carbohydrate tolerance. It is *severe* if the sugar cannot be removed from the urine by eliminating all carbohydrate from the diet and restricting the intake of protein food. It is *grave* if on such a diet, in addition to sugar, the acetone bodies are present in the urine.

The next step in the treatment is to institute measures to keep the urine sugar-free and if possible to increase the tolerance for carbohydrates. The urine in many cases can be rendered sugar-free by the total exclusion of the carbohydrates from the diet. Such a regimen is not tolerated long nor is it capable of maintaining the patient permanently in weight equilibrium. Sooner or later the patient grows disgusted with his dietary and lapses into indiscretions or rapidly goes downhill in health and spirits. Moreover, on a carbohydrate-free diet some patients run the risk of diabetic acidosis and diabetic coma, for when the carbohydrates are withheld for a long period of time from the dietary the fats are not properly oxidized and the toxic acetone bodies are formed. The withdrawal of the carbohydrates therefore acts as a double-edged sword—it lessens the hyperglycemia, but it also favors the development of acidosis. If acidosis is present the proper measures to be further described must be taken.

Physicians should be familiar with the possible complications of diabetes so that at the earliest moment steps may be taken to combat them.

It goes without saying that a study of the case that limits itself to an examination of the urine is entirely inadequate. A thorough general examination of the body must be made, including the blood pressure, the eyes and eye grounds, and the nervous system. Furthermore, the general habits of life of the patient must be investigated: his work, his means and methods of relaxation, his sleep, his sexual life, etc., for the diabetic state is profoundly under the influence of the "psyche." Some writers, indeed, speak of a neurogenic diabetes, but a permanent diabetes on such a basis is rare, if it occurs at all. Temporary glycosurias after cerebral injuries are met with, as already mentioned, but if they pass into confirmed diabetes it is altogether probable that the pancreas or some other diabetogenic organ has become involved. There is, however, no doubt as to the ability of the nervous system to influence sugar production both in health and in diabetes. The pathway from the brain to the splanchnics and the adrenals has been sketched on a previous page. Diabetic patients made sugar-free or in whom the sugar has been greatly reduced often show a return of sugar or an increase after severe nervous shock. Nervous excitement is also capable of precipitating diabetic coma. It is, therefore, of the utmost importance to lessen the strain and fret so common in the life of the American business man. One of my patients whose business brought him many vexations improved in a remarkable manner when he took off several days during the week in the summer to go fishing.

The secret of success in treating diabetes lies not alone in instituting the proper dietetic measures, but also in paying strict attention to all the details of life, which naturally vary in different cases. The bowels need careful attention, for diabetics are usually constipated. Effervescent citrate of magnesia and other sweetened laxatives are of course out of question. The bitter salines are useful, likewise phenolphthalein, which may be combined with rhubarb in capsule form, of each gm. 0.12 to 0.18 (2 to 3 grains). Care should be given to the mouth on account of the danger of pyorrhea alveolaris. Milk of magnesia as a mouth wash and iodine applications, together with skilful scaling of the teeth by a dentist, are beneficial measures. Trifling wounds should not be neglected, as the lessening of the opsonic index (DaCosta and Beardsley, 13, and Sisto, 73) predisposes to infection.

The essential point in the dietetic treatment consists in bearing constantly in mind the impaired tolerance of the diabetic for carbohydrates. By not overtaxing this tolerance the power of assimilation for carbohydrates is not only conserved, but in the majority of cases is increased.

The aglycosuric state has a splendid effect on the carbohydrate tolerance, tending to raise it. At the same time the information that his urine has become sugar-free cheers the patient. Yet this knowledge is not with-

out danger, for sometimes patients believe themselves cured and relax in their dietetic abstemiousness. The sparing of the carbohydrate tolerance or *Schonung*, as the Germans call it, is accomplished by decreasing or excluding the carbohydrates from the diet, and in severe cases by also lessening the total intake of food.

In the mild cases in which a few days of carbohydrate-free diet suffice to render the patient sugar-free it is wise to continue such a diet for about two weeks, as recommended by Naunyn (58); gradually thereafter carbohydrate is added, beginning with a slice of bread, a potato, an apple, or an ounce or two of cream, the urine being frequently examined for sugar. No sugar appearing, the tolerance is tested after a few weeks by giving 100 to 200 grams of bread. If sugar appears with 200 grams but not with 100 grams the tolerance lies between the two. Some, particularly Kolisch, advocate the giving thereafter of the whole amount tolerated, while von Noorden and Falta (14) give only one-half or two-thirds; that is, if 100 grams are assimilated the patient is allowed 66 grams. The latter, I believe, is the safer plan. By making use of the table of equivalents on pages 739 to 741 the carbohydrates in the diet can be varied within wide limits. As long as there is no ketonuria the organism can exist for a considerable period on a diet poor in carbohydrates.

The caloric needs of the diabetic are the same as those of a healthy man equally active—about 35 calories per kilogram of body weight, which for a man of 70 kilograms (150 pounds) is about 2,450 calories. About 1,800 of these normally are derived from carbohydrates, but since the diabetic cannot utilize carbohydrates he has to make up the deficiency in his caloric needs by means of protein and fat. It has been found by experience that the protein cannot be much increased beyond the normal, at the most up to 150 grams, equal to 400 calories. On account of their great caloric value (one gram equals 9.3 calories) the amount of fat required is not very large (about 200 grams, six ounces), but in practice it is not easy to induce patients to take this amount day in and day out. Janeway and von Noorden have pointed out the value of alcohol in increasing the tolerance for fats. A little whiskey or light wine may therefore be added to the dietary.

In making out diet lists for a diabetic patient the physician should remember that the man who finds that he is deprived of bread, potatoes, and similar staples considers himself very much restricted and is likely to harp continually on his privations. It is therefore wise to make the allowed list as extensive as possible, so that the patient may be conscious of a wide latitude of choice. For this reason the practitioner will find the large and inclusive tables of von Noorden suggestive and helpful. I cannot do better than copy these tables, which are now in almost universal use (Foster, 18, Janeway, 29, Tyson, 77). Von Noorden gives four lists. The first he designates as "Unbedingt erlaubte Nahrungsmittel"—Foods

unconditionally allowed. The second is a list of foods allowable in restricted quantities. The third comprises a table of equivalents for carbohydrate foods. Every portion of these foods takes the place of an equivalent quantity of bread in the dietary. A fourth table contains a list of foods particularly valuable for the diabetic by reason of their high fat and protein content. In a fifth table is shown the carbohydrate content of certain vegetables and fruits. Abundant use should be made of the articles mentioned in Table IV for the purpose of raising the nutritional or caloric value of the dietary to the required minimum.

By varying the mode of preparation of the different articles the bill of fare in the individual cases can be still further amplified.

TABLE I

Foods for the Most Part Unconditionally Allowed

FRESH MEATS.—All muscle of beef, veal, pork, lamb, mutton, game, either roasted, boiled, or broiled, in their juices, with butter, or with mayonnaise made without flour, either hot or cold.

VARIOUS ORGANS OF ANIMALS.—Tongue, heart, brains, sweetbreads, kidneys, marrow, calves' liver, liver of game or poultry (*paté de foie gras*) up to 100 grams in weight, weighed after being prepared.

PRESERVED MEAT.—Smoked meat, dried meat, smoked or pickled tongue, ham or bacon, corned beef, sausage (containing no bread).

Meat extracts of all kinds, meat jellies or aspics prepared from calf's foot, gelatin, and meat sauces.

FRESH FISH.—All fresh fish boiled, fried, or broiled. If the fish is fried in bread crumbs the crust must not be eaten. All sauces free from lard are allowed; those containing butter and lemon are best.

PRESERVED FISH.—Dried, salted, or smoked, such as haddock, cod, herring, mackerel, flounder, sardelle, sturgeon, cels, salmon, etc. Pickled herrings, sardines in oil, mackerel in oil, anchovy, tunnyfish, etc.

SHELL FISH AND CRUSTACEANS.—Oysters, clams, and other shell fish, lobsters, crabs, shrimps, turtle, etc.

EGGS.—Raw or cooked.

FISH PRODUCTS.—Caviar, roe.

FATS.—Butter, bacon, lard, suet, oleomargarin, olive oil, cod-liver oil. Rich cream is permitted up to six ounces a day—one of its chief uses is as a substitute for flour in preparing sauces, etc.

Milk, especially the so-called diabetes milks, which are, however, difficult to obtain in this country. On page 742 a recipe for making a sugar-free milk will be found.

Cheese of all kinds, especially cream cheese, not to exceed, however, 50 grams a day.

VEGETABLES.—Salads: lettuce, endive, romain, cress, dandelion; celery without root, cucumbers, tomatoes, young string beans, egg plant,

onions, kohl-rabi (young), radishes, asparagus, Brussels sprouts, cauliflower, artichoke, spinach, cabbage, mushrooms.

Canned and preserved vegetables: canned asparagus, canned young string beans, sauerkraut, olives, pickles.

NUTS.—Walnuts up to 6 a day, hazelnuts 10, almonds 10, cream nuts 8, peanuts 10.

FRUIT.—Cranberries, rhubarb, green gooseberries (sweetened with saccharin).

SOUPS AND CONDIMENTS.—Meat soups and sauces (Worcestershire, etc.) in moderation.

Desserts made from eggs, cream, almonds, lemon, and gelatin, sweetened with saccharin instead of sugar.

BEVERAGES.—Carbonated waters, whiskey, brandy, light Moselle and Rhine wines, Bordeaux and Burgundy of old vintage, tea and coffee with cream but without sugar, cocoa in small amounts, and lemonade.

TABLE II

Foods Allowed in Restricted Quantities

Vegetables cooked without flour and sugar: lima beans, dry and green peas, a tablespoonful; red beets, white kohl-rabi, carrots, celery root, oyster plant, two tablespoonfuls.

Potato: a small potato or a tablespoonful of mashed or fried potato.

FRESH FRUITS.—Apples, pears, apricots, peaches, up to an ounce and a half; raspberries, strawberries, currants, blackberries, two tablespoonfuls; huckleberries, three tablespoonfuls.

Cooked fruits without sugar, with saccharin if necessary: plums, prunes, apples, pears, apricots, peaches, sour cherries, a heaping tablespoonful; raspberries, unripe gooseberries and currants, two tablespoonfuls.

Dried fruit: prunes and peaches cooked after thorough washing in water, one tablespoonful.

The following table of equivalents was prepared for me by Dr. C. B. Farr along the lines of the preceding table but in a way better adapted to the needs of the kitchen.

TABLE III

Table of Equivalents A

Foods containing carbohydrates, to be used only in restricted quantity, which when used entail a cutting down of the bread allowance in a proportionate amount. Modified from Janeway's and Foster's tables.

	Per Cent. Carbo- hydrates	Grams	Grams	Grams	Grams	Amount in Ounces Equal to 1 Ounce White Bread
White bread	51-55 Equiv. to	10 Equiv. to	20 Equiv. to	30 Equiv. to	50 Equiv. to	1
Corn bread	46	12	24	35	60	1½
Graham bread	47-53	10	20	30	50	1

TABLE III—Continued

	Per Cent. Carbo- hydrates	Grams	Grams	Grams	Grams	Amount in Ounces Equal to 1 Ounce White Bread
Gluten bread.....	47-53	13	26	39	65	1 $\frac{1}{8}$
Rolls and biscuit.....	52-60	.....	.....	.....	.....	1
Crackers, average.....	69-72	.....	.....	.....	.....	$\frac{3}{4}$
Oat cakes.....	.....	25	50	75	125	.....
Wheat flour.....	.....	8	16	24	40	.....
Hominy (boiled).....	.....	20	38	50	.....	.....
Rice (boiled).....	.....	14	28	42	.....	.....
Tapioca (pudding).....	.....	15	30	45	.....	.....
Macaroni (cooked).....	15.8	30	60	90	.....	3
Spaghetti (cooked).....	.....	30	60	90	.....	.....
Cocoa (unsweetened).....	.....	12	.....	.....	.....	.....
Vegetables:						
Asparagus (cooked).....	.....	175	350*	.....	.....	.....
Beans, red kidney.....	.....	25	50	.....	.....	.....
Beans, baked.....	20	.....	.....	.....	.....	2 $\frac{1}{2}$
Beans, lima.....	20	25	50	.....	.....	2 $\frac{1}{2}$
Beets (cooked).....	.....	55	100	.....	.....	.....
Cabbage (raw).....	.....	78	156	.....	.....	.....
Carrots (raw).....	.....	60	120	.....	.....	.....
Celery (raw).....	.....	100	200	.....	.....	.....
Corn, green, canned.....	.....	25	50	.....	.....	.....
Cauliflower (raw).....	.....	80	160	.....	.....	.....
Dandelion greens.....	.....	50	100	.....	.....	.....
Egg plant (cooked).....	.....	90	180	.....	.....	.....
Onions (boiled).....	.....	90	180	.....	.....	.....
Peas, green (cooked).....	15	30	60	90	.....	3
Parsnips (raw).....	13	40	80	.....	.....	4
Potato (boiled).....	.....	25	50	75	.....	.....
Potatoes, cooked.....	18-20	.....	.....	.....	.....	3
Cereals:						
Oatmeal, boiled.....	11.3	.....	.....	.....	.....	5
Hominy, boiled.....	17.8	.....	.....	.....	.....	3
Rice, boiled.....	24.4	.....	.....	.....	.....	2 $\frac{1}{8}$
Milk.....	4-5	.....	.....	.....	.....	10
Fruits:						
Apples and apricots.....	12-14	.....	.....	.....	.....	4
Apples (raw).....	.....	35	70	.....	.....	.....
Apricots (stewed).....	.....	40	80	.....	.....	.....
Bananas.....	22	25	50	.....	.....	2 $\frac{1}{2}$
Blackberries (fresh).....	.....	35	70	.....	.....	.....
Cherries (fresh).....	15	25	50	.....	.....	2 $\frac{1}{2}$
Currants (fresh).....	.....	40	80	.....	.....	.....
Grape fruit.....	.....	200	.....	.....	.....	.....
Gooseberries.....	.....	75	150	.....	.....	.....
Oranges.....	.....	30	60	.....	.....	.....
Peaches.....	.....	50	100	.....	.....	.....
Pears.....	12-14	40	80	.....	.....	4
Plums.....	20	27	54	.....	.....	2 $\frac{1}{2}$
Prunes (stewed).....	.....	25	50	.....	.....	.....
Raspberries.....	.....	42	84	.....	.....	.....
Strawberries.....	.....	60	120	.....	.....	.....
Huckleberries.....	16	.....	.....	.....	.....	3 $\frac{1}{4}$
Nuts:						
Filberts.....	12	.....	.....	.....	.....	4 $\frac{1}{2}$
Almonds.....	15	.....	.....	.....	.....	3 $\frac{1}{2}$
Peanuts.....	22	.....	.....	.....	.....	2 $\frac{1}{2}$

* When no equivalent amount is given in the fourth column, it is to be understood that the amount in the third column is the maximum allowable.

Table of Equivalents (Carbohydrates) B

This table shows the amounts of various carbohydrate foods which will yield 15 or 16 grams of carbohydrate, or the equivalent of a slice of bread. The calories are also given. It is intended for use with the "Strict" diet to facilitate the determination of the carbohydrate "tolerance."

Article	Amount	Rough Measure	Protein, Grams	Fat, Grams	Carbo-hydrate, Grams	Calories	Remarks
Bread.....	30 grams	slice	2.76	.39	15.93	80	"Educator"
Zwieback.....	22.4 grams	1½ slices	2.20	2.23	16.53	97	
Soda crackers.	33 grams	11 crackers	10.67	.....	15.29	110
Macaroni (boiled)....	100 grams	2 h. tbsp.	3.00	1.50	15.80	91	
Rice (boiled)...	66 grams	¾ tbsp.	1.87	.07	16.00	75	Large portion 4 or 5 portions
Potato (bak'd)	65 grams	½ medium	1.88	.10	16.03	74	
Green peas...	110 grams	3½ tbsp.	7.39	3.75	16.11	132	
Carrot.....	450 grams	12 h. tbsp.	2.38	.76	15.25	81	
Milk (whole).	330 grams	1½ glasses	10.89	13.20	16.50	235	
Apple (raw)...	150 grams	large	.45	.45	16.00	72	
Grape fruit...	150 grams	¼ large	1.18	.30	15.13	69	

TABLE IV *

100 Gm. (A Trifle over Three Ounces)	Protein	Fat	Carbo-hydrates	Caloric Value
Vegetable oil.....	1	100	.....	930
Butter.....	1	85	0.5	830
Bacon (salt or smoked).....	10	76	.....	748
Devonshire cream.....	2	57	0.2	538
Cream cheese (Gervais, Neufchâtel, Stilton, Stracchino, etc.).....	19	41	0.1	451
German sausage (Cervelatwurst).....	18	40	.....	456
Ham.....	25	36	.....	437
Cheddar cheese.....	28	33	0.2	422
Fat pork.....	14	37	.....	400
Smoked ox-tongue.....	24	32	.....	396
Fatty cheese (average).....	25	30	1.5	381
Yolk of egg.....	16	31	0.5	354
Fat goose.....	16	30	.....	345
Fat beef and mutton.....	17	29	.....	337
Brie cheese.....	19	26	0.1	320
Fresh-water eel.....	13	28	.....	312
Smoked mackerel.....	19	22	.....	382
Caviar.....	31	16	.....	276
Cream.....	4	23	0.4	230
Fat salmon (fresh or smoked).....	22	13	.....	210
Hens' eggs (weighed with the shells) (2 large).....	12	10	0.5	142

* From Hall (Nutrition and Dietetics, 1910, pp. 263-4).

TABLE V

A. Vegetables in which the proportion of carbohydrates is less than 4 per cent. Of these the patient may partake freely:

String beans.....	1.9
Asparagus (cooked).....	2.
Endive.....	2.2
Spinach.....	2.8
Lettuce.....	2.9
Cucumbers.....	3.1
Beet greens.....	3.2
Celery.....	3.3
Chard.....	3.4
Brussels sprouts.....	3.4
Sauerkraut.....	3.9
Tomato.....	3.9

B. Vegetables containing from five to ten per cent. carbohydrate. These may be taken to the amount of three ounces a day.

Onions.....	5.5
Okra.....	7.4
Turnips.....	8.1
Carrots.....	9.3
Squash.....	10.0

There is considerable variation in the carbohydrate contents of some of these vegetables.

C. Fruits below 12 per cent:

Lemons, watermelons, strawberries, gooseberries, muskmelons, cranberries, blackberries, currants, grape-fruit, oranges, raspberries, sour apples.

Milk.—Milk on account of its lactose or milk sugar content is not an indifferent food for diabetics, and the so-called “milk cures” may prove harmful. If good follows them it is due rather to the incidental under-feeding increasing the tolerance for sugar than to any better utilization of milk sugar over other forms of carbohydrate. Attempts have been made to obtain sugar-free milk. Williamson recommends the following method for preparing a sugar-free milk: Mix 3 or 4 tablespoonfuls of fresh cream with a pint of water in a glass. After from 12 to 24 hours remove the fat that has collected on the surface and mix with an equal volume of water and with white of egg until it has the appearance of ordinary milk. Add saccharin and salt to taste. This mixture contains practically no sugar. Kefir and kumyss contain comparatively little sugar. In ordinary sour milk and buttermilk, however, the sugar is but little reduced.

Cream.—Cream is of great value in the treatment of diabetes. Although it contains from three to four per cent. of sugar, it is permissible since it is seldom used in large quantities, hardly more than six ounces

per day. Aside from its use in tea and coffee it is valuable in the preparation of sauces, etc.

Cheese.—Cheese contains large amounts of fat—15-30 per cent. in the better qualities; those made from sour milk (clabber) contain only about 3 per cent. As the protein content of cheese is double that of meat, a portion of good cheese is equal to $1\frac{1}{2}$ to 2 portions of fatty meat. Grated Parmesan cheese is much used in Europe for “binding” instead of flour.

Butter and Other Fats.—The fats are of great value in the dietetic treatment of diabetes. They are the best means for compensating the body for the loss of sugar through the urine. As they are well borne and have a high caloric value, the amount necessary is not large. Ordinarily about 150 grams may readily be taken in a day, yielding, after allowing for loss in the feces, about 1,200 or 1,300 calories. Fat may be given in the form of butter, cream, and oil (olive oil, salad oil, cod-liver oil). Butter may be used and should be used as an addition to all sorts of allowed foods, especially the vegetables. Von Noorden (*loc. cit.*) has prepared a table showing how much butter or oil can be added to various vegetables without impairing their taste or appearance.

To 125 grams raw weight red cabbage or sauerkraut, 25 grams.

To 125 grams raw weight spinach, 40 grams.

To 125 grams raw weight salad, 30 grams oil.

To 125 grams raw weight beans, 25 grams butter.

To 125 grams raw weight string beans, 40 grams butter.

Bacon.—There is marked difference between fat and lean bacon. The fat contains 92 per cent. fat and the lean only 7 per cent. Bacon may be added to vegetables, to meats, poultry, salads, etc.

Meat.—Meat in cooking or roasting loses about 25 per cent. water. Five hundred grams cooked meat are equal to about 650 grams raw. Lamb and pork contain much fat. Venison, being poor in fat, has a lesser caloric value. Poultry, except that especially fattened, is also poor in fat. Fish is for the most part poor in fat, though a few have a high fat percentage—the eel 25 to 30 per cent. Sweetbreads are similar to beef in protein and fat content. Liver, except in small amounts, is excluded by reason of its glycogen. Pâté de foie gras is rich in fat and poor in glycogen, hence allowable. Although meat belongs to the staples of the diabetic's diet, it must not be used in large amounts, especially in severe cases and in those with acidosis.

Eggs.—Eggs weigh from 50 to 60 grams apiece. Their nutritive value is greater than that of meat by reason of the high fat content—10 to 20 per cent. in the whole egg and 30 per cent. in the yolk. The caloric value of one egg is 75 calories. It might be mentioned that Luthje (40) claims

that the yolk may raise the glycosuria through its content of lecithin, but I believe that this point may be disregarded.

Vegetables.—Where the treatment involves meat restriction the vegetables assume a prominent place in the dietary. They subserve three distinct purposes: They satisfy in part the craving of the diabetic for food, they stimulate peristalsis, and they are an excellent vehicle for fat. Those vegetables are to be chosen which contain less than 5 per cent. carbohydrate. Even a part of this may be removed by boiling the vegetables in water and pouring the water off. (See table of vegetables.) The cellulose of vegetables, a carbohydrate, does not seem to augment the glycosuria, although it is probably in part digested in the intestines. (Schmidt and Loerisch; 69, 70.)

Alcohol.—Much has been written on the use of alcohol in diabetes. It is certain that alcohol as such does not unfavorably influence the elimination of sugar. Its high caloric value, one gram equaling seven calories, makes it a valuable adjunct in the dietetic treatment. It seems to favor the tolerance for fats, and, as von Noorden says, it compensates the diabetic patient for other deprivations.

It makes but little difference in what form the alcohol is taken, provided that the sweet wines and the malt liquors are debarred. Among sweet wines to be forbidden may be mentioned port, madeira, and tokay. Whiskey, brandy, Moselle and Rhine wine, and most of the red wines may be permitted. Beer and similar beverages contain carbohydrates that are badly utilized. They are therefore not permitted except in the mildest cases or perhaps during coma. The amount of alcohol estimated as absolute alcohol that a patient may be allowed is from 30 to 70 grams per day (1 to 2 oz.).

The following table gives the carbohydrate content and caloric value of the more important alcoholic beverages:

CARBOHYDRATE CONTENT AND CALORIC VALUE OF ALCOHOLIC BEVERAGES

	Per 100 G.	
	Carbohydrate	Calories
Beer.....	4.0	41
Moselle and Rhine Wine.....	0	57
French Red Wine.....	1.0	65
Champagne.....	12.0	120
Port Wine.....	5.8	149
Cognac.....	0.7	298
Liqueurs.....	28-34	300-440

Nuts.—Most of the nuts, such as almonds, butternuts, Brazil nuts, filberts, pecans, hickory nuts, walnuts, hazel-nuts, cocoanuts, peanuts, are

valuable additions to the food of diabetics. Chestnuts must be excluded because of the large quantity of starch they contain. Jaffa, of the University of California (U. S. Dep. of Agriculture, Farmers' Bulletin 332), has made a very thorough study of the composition and food value of nuts.

TABLE VI

EDIBLE PORTION OF NUTS (JAFFA)

	Water	Protein	Fat	Carbohydrates		Ash	Fuel Value per Pound
				Sugar, Starch, Etc.	Crude Fiber		
	%	%	%	%	%	%	Calories
Butternut.....	4.5	27.9	61.2	3.4		3.0	3,370
Brazil nut.....	4.7	17.4	65.0	5.7	3.9	3.3	3,120
Pecan nut.....	3.4	12.1	70.0	8.5	3.7	1.6	3,300
Hickory nut.....	3.7	15.4	67.4		11.4	2.1	3,345
Filbert.....	5.4	16.5	64.0		11.7	2.4	3,100
Cocoanut.....	13.0	6.6	56.2	13.7	8.9	1.6	2,805
Almond.....	4.9	21.4	54.4	13.8	3.0	2.5	2,895
Pistachio.....	4.2	22.6	54.5	15.6		3.1	3,250
Walnut.....	3.4	18.2	60.7	13.7	2.3	1.7	3,075
Walnuts, black.....	0.6	7.2	14.6		3.0	0.5	730
Walnuts, English.....	1.0	6.9	26.6		6.8	0.6	1,250
Chestnuts, fresh.....	43.4	6.4	6.0	41.3	1.5	1.4	1,140
Chestnuts, dry.....	6.1	10.7	7.8	70.1	2.9	2.4	1,840
Chestnut flour.....	7.8	4.6	3.4	80.8		3.4	1,780

The composition of peanuts as found by different analysts is given in the following table:

TABLE VII

PEANUTS (EDIBLE PORTION)

	Water	Ash	Ether Extract (Fat)	Protein (Nitrogen $\times 6.25$)	Carbohydrates	Fiber	Fuel Value Per Pound
	%	%	%	%	%	%	Calories
Atwater.....	6.90	1.50	20.10	19.50	18.50	.....	1775
Atwater and Bryant...	9.20	2.00	38.60	25.80	24.40	2.50	2560
Jaffa.....	7.40	2.20	43.50	29.80	14.70	2.40	2610
Fetterolf.....	3.05	2.30	49.99	31.00	13.66	.....	2939

The following table of the composition of shellfish may prove useful:

TABLE VIII
SHELLFISH, FRESH*

	Water	Protein N \times 6.25	Fat	Carbo- hydrates
Clams, long, in shell, as purchased, average	49.9	5.0	0.6	1.1
Crabs, hardshell, whole, edible portion	77.1	16.6	2.0	1.2
Lobster, whole, average	79.2	16.4	1.8	0.4
Oysters in shell, average	86.9	6.2	1.2	3.7
Terrapin, edible portion	18.3	5.2	0.9	

* Atwater and Bryant (2).

Bread.—Many laymen think that toast is allowable, though fresh bread is not. This, of course, is a mistake. The unleavened bread, or matzos, used by the Jews during the Passover holidays, should also be prohibited. In a patient under my observation who had been sugar-free for a long time on an ordinary diet, the eating of unleavened bread and the drinking of sweet wines customary during these holidays brought about a return of glycosuria.

Many efforts have been made to find a substitute for ordinary baker's bread. Notwithstanding, however, the claims of manufacturers that their preparations are starch-free and safe for diabetics, analyses show that both the diabetic breads and the diabetic flours contain starch. It is indeed impossible to make a satisfactory "bread" containing less than 30 per cent. carbohydrate. The much used German "Lufbrot" or air bread contains about 33 per cent. starch. An instructive table regarding the composition of commercial diabetic bread and flour has been published by D. W. Fetterolf (15). It is given on page 747. An analysis of European, more particularly German, diabetic foods has been made by Magnus-Levy (45). Contrary to the statements of manufacturers the majority of diabetic breads do not contain more fat than normal bread; yet it is desirable that the fat content of such bread should be increased. Magnus-Levy thinks that two kinds of diabetic bread are sufficient for practical purposes; one with a maximum content of starch of 30 per cent., half the normal; and one real bread substitute with either five or ten per cent. starch. With a content of less than 5 per cent. a palatable bread food cannot be made. Of the bread containing 30 per cent. starch the diabetic may eat twice as much as of the ordinary bread or rolls with 60 per cent. Such an increase in the bulk of bread is an advantage for many patients. It is desirable that the diabetic foods should present a better guarantee of their composition than is now the case. The analyses should be made only in recognized scientific institutes.

A fairly palatable bread substitute may be made from almond flour according to the following formula:

Take three cups of almond flour, a pinch of salt, and a pinch of saccharin. Beat up three eggs in a pan, add a cup of milk to the eggs, then the flour, and stir to make a soft batter. Spread the batter about three-quarters of an inch thick, using a pan about nine by twelve inches in size.

TABLE IX

Fetterolf (University of Pennsylvania Medical Bulletin, Sept., 1909)
United States Products. Analysis of Material as Purchased.

Material	Manufacturer	Protein (Nitrogen × 6.25)	Carbohydrate Including Fiber (by Difference)
Pure gluten flour	Battle Creek Sanitarium Food Com- pany, Michigan	% 78.75	% 12.62
40 per cent. gluten flour.	Battle Creek Sanitarium Food Com- pany, Michigan	39.00	50.16
Self-raising 40 per cent. gluten flour	Battle Creek Sanitarium Food Com- pany, Michigan	38.69	50.10
20 per cent. gluten flour.	Battle Creek Sanitarium Food Com- pany, Michigan	21.00	68.25
Pure gluten biscuit	Battle Creek Sanitarium Food Com- pany, Michigan	48.31	39.06
40 per cent. gluten bis- cuit	Battle Creek Sanitarium Food Com- pany, Michigan	36.37	51.94
Potato gluten biscuit . . .	Battle Creek Sanitarium Food Com- pany, Michigan	75.63	13.23
Pure gluten flour, "Glu- tosac"	The Health Food Company, N. Y..	35.25	55.03
Gluten flour	Unknown, Danville, N. Y.	15.50	70.83
Diabetic flour	Farwell & Rhines, N. Y.	11.97	76.41
Diabetic biscuit flour . . .	Unknown	75.25	5.89
Plasmon meal	Plasmon Company of America, New York City	78.65	None
Wheat Flours for Com- parison:			
Wheat flour "Hungarian"			74.70
Wheat flour, patent roller process, high grade . . .	Average	11.20	74.90

Soja.—Soy flour is derived from the fruit or seeds of the *Soja hispida*, a leguminous plant of the order Phaseolaceæ cultivated in China and Japan. The seeds contain an unusual amount of protein (30 to 35 per cent.) and a small amount of carbohydrate (about 6 per cent.), besides a fatty oil, lecithin, etc. Their nutritive content varies, however, considerably. In Japan the seeds are largely used as a vegetable, but they leave an unpleasant taste, and in their unaltered state have, as von Noorden shows, a bad effect on the elimination of sugar in diabetes. In this country they are used as fertilizer, the seeds being sown and after growth plowed under. There is now on the market a proprietary preparation called sarton which is said to be free from starch and sugar and is more palatable than the original seed. It occurs in the form of a powder or paste and may be used in the preparation of soups. Sarton seems to stimulate intestinal peristalsis without causing the formation of gas, a quality of distinct advantage in diabetic patients. Tests with sarton (von Noorden and Lampé, 61) show that in mild cases the elimination of sugar is not influenced by it. In cases of moderate severity, sugar-free on a strict diet, from 80 to 100 grams (2 2/3 to 3 1/3 ounces) are well

tolerated. In the more advanced cases soy soup, as a rule, causes no increase in the sugar elimination when given in the aforementioned quantities.

Soja bean flour unfortunately has a disagreeable odor. Useful directions for making gruels, broths, and muffins will be found in an article by Friedenwald and Ruhrah (20).

The following is an analysis of Soy Bean Gruel Flour, furnished by the manufacturers, the Cereo Co., of Tappan, N. Y.:

Proteids (N x 6.25), 44.64 per cent.

Fat, 19.43 per cent.

Mineral Matter, 4.20 per cent.

Moisture, 5.26 per cent.

Crude Fiber, 2.35 per cent.

Cane Sugar, 9.34 per cent.

Nonnitrogenous Extract, 14.78 per cent.

Starch, none.

Reducing Sugar, none.

Substitutes for Sugar and Vegetable Starch.—Many attempts have been made to replace the ordinary types of vegetable starch—the chief source of sugar in the body—with other forms of starch, in the hope that they would be better utilized by the diabetic. There are certainly differences in the assimilability of the different forms of starch, but they are not well understood. Below are a few of the substitutes that have been suggested:

LEVULOSE.—While some maintain that this is better tolerated than glucose, others find no difference between the two substances. In every case in which levulose is ordered tests should be made of its tolerance. Von Noorden recommends it in cases of diabetic coma, 100 grams by the mouth, or subcutaneously in a 10 per cent. solution. As most of the fruits contain their sugar in the form of levulose, they may be used when levulose is to be given.

MILK SUGAR.—For a time this was thought to be harmless, but it has been definitely shown that it has the same effect as glucose and starch, hence "milk cures" are harmful for diabetics. In the few cases in which good results have been obtained, they were probably due to the incidental underfeeding affecting the sugar tolerance favorably.

INULIN.—Inulin is a polysaccharid of levulose. It is the chief constituent of certain tubers, e. g., helianthus, topinambur, stachys, black root, artichoke, dandelion, etc. In the opinion of Strauss (75) inulin is more readily assimilated than other vegetable starch. Strauss made a careful study in several cases using at first pure inulin and then inulin-containing plants and found that both had a distinctly favorable influence upon the elimination of sugar and upon acidosis. In the following table is given the composition of the various inulin-containing tubers:

	Water	Reducing Sugar	Inulin	Nitrog- enous Sub- stances	Pure Proteid	Fat and Fibers	Ash
	%	%					
Helianthus—weak tubers..	69.77	0	19.85	4.33	2.86	1.77	1.56
strong tubers	67.85	0	16.87	3.80	2.75	1.74	2.00
white tubers	71.75	1.96	20.12	4.04	1.73	.....	1.46
red tubers..	82.09	1.41	8.01	3.64	1.90	.....	1.25
Topinambur tuber.....	72.62	0.17	12.91	1.97	0.81	.....	1.89
Dahlia tuber.....	83.34	1.27	10.32	0.74	.....	.....	1.38

Regarding the preparation of the helianthus tubers Strauss found that patients preferred them roasted like potatoes, though they were also readily taken when boiled in salt water and served with hollandaise sauce or with mayonnaise dressing. They may be given as purée, or as salad with oil and vinegar. The price of inulin and of the inulin-containing vegetables is high, but if the cultivation of the plants is encouraged the price ought soon to become more reasonable. Strauss believes that inulin will be found especially valuable when acidosis is present.

Substitutes for Sugar.—As a substitute for sugar saccharin, an anhydrid of orthosulphanidbenzoic acid (benzoyl sulphonicimid) is in general use. It occurs as a white crystalline powder, nearly odorless, having a sweet taste even in very dilute solutions. It is soluble in 250 parts of water and in 25 parts of alcohol, and is said to be 300 times sweeter than sugar. It is not converted into glucose in the body. In a careful study of the influence of saccharin on digestion, metabolism, nutrition, and general health, made by the Referee Board of Consulting Scientific Experts of the Department of Agriculture, the following conclusions were reached:

(1) Saccharin in small quantities (0.3 gram per day or less) added to the food is without deleterious or poisonous action and is not injurious to the health of normal adults, so far as is ascertainable by available methods of study.

(2) Saccharin in large quantities (over 0.3 gram per day and especially above 1 gram daily) if taken for considerable periods of time, especially after months, is liable to induce disturbances of digestion.

(3) The admixture of saccharin to food in small or large quantities has not been found to alter the quality or strength of the food. It is obvious, however, that the addition of saccharin to food as a substitute for cane sugar or some other form of sugar must be regarded as a substitution involving a reduction of the food value of the sweetened product and hence as a reduction in its quality. For many people saccharin has an after taste more or less bitter that makes it objectionable.

Other substitutes for sugar are crystallose and dulcin. The latter is about as sweet as saccharin but has slightly toxic properties.

Glycoheptonic acid, recently recommended by Rosenfeld (67), is a saccharid having 7 instead of 6 carbon atoms. Under the trade name of lakton it is recommended as a substitute for sugar in doses up to ten grams.

DIETETIC REGIMEN FOR DIABETIC CASES IN PRACTICE

As stated on a previous page, a given case must be ranged into one of the four groups: mild, moderately severe, severe, or grave. Let us assume that we are dealing with a *mild* case. We would arrange the diet as follows: We would put the patient for a few days on the strict diet given in Table XI, writing out for him in full all the details. The case being a mild one the sugar will disappear in a few days; nevertheless the strict dietary is continued for two weeks. No drugs are necessary unless indicated by some subsidiary or accidental condition: most frequently perhaps an occasional laxative such as one of the alkaline bitter waters or phenolphthalein and rhubarb is needed. The next step is to give the patient a slice or two of bread a day, watching the effect on the urine. If no sugar appears a little more bread may be given or an equivalent amount of another carbohydrate (see Table III). By watching the urine and weight it is possible in mild cases to increase considerably the starch in the patient's food. The increase, however, should not be by leaps and bounds, and the patient must be warned against indulging any craving he may have for pastry and sugar. Von Mering thinks the diabetic should abstain from sugar throughout life; von Noorden is not only of the same opinion, but restricts or forbids sugar even in the case of an individual in whose family diabetes exists.

We must gain the patient's confidence and coöperation by explaining to him the necessity for self-control and the dangers that lurk in self-indulgence. Every patient should carry with him a list of allowed and forbidden foods and should be told when in doubt to abstain. The following is such a list:

TABLE X

A. *Forbidden to All Diabetics*

Sugar.	Gravies, sauces, and soups thickened with flour.
Candy.	Hot cakes.
Maple sugar.	Cereals.
Pies.	Rice.
Pastry.	Dried beans.
Cake.	Sweet wines.
Jelly.	Macaroni.
Preserves.	Ginger ale.
Compotes or stewed fruits.	Champagne.
Ice cream.	Liqueurs.
Syrups, molasses.	

B. Allowed Only by Special Permission and in Specified Quantities

Bread.

Potatoes.

Crackers.

Vegetables containing more than 5 per cent. starch (see list on page 742).

C. Allowed

Butter.

Cream up to 6 ounces a day.

Bacon.

Clear meat broths.

Salad oil.

Meats.

Olive oil.

Eggs.

Cheese, especially cream cheese.

Fish.

Vegetables containing less than 5 per cent. carbohydrate (see list on page 742).

As Desserts

Jellies, custards, or ice cream made with cream and eggs, sweetened with saccharin and flavored with vanilla, coffee, lemon, or brandy.

TABLE XI

*Standard Strict Diet**

Meals, Articles, Amounts, Rough Measure				Protein	Fat	Carbo- hydrate	Calories	Total
				Grams	Grams	Grams		
Breakfast:								
Coffee								
(with) cream (aver.),	40	gm., or 2 tbsp		1.48	10.28	1.42	108	
Eggs,	100	" 2 ave.		13.40	10.50		152	
(with) butter,	15	" 1 ball.		0.15	12.75		119	
Ham, fried	100	" 1 slice.		23.31	34.86		400	779
Luncheon:								
Bouillon,	120	gm., 1 cup.		2.64	0.12	0.24	13	
(with) egg,	50	" 1 ave.		6.70	5.25		76	
Tenderloin steak	100	" 1 slice.		23.50	20.40		286	
Bacon,	30	" 1 slice.		3.15	19.44		194	
Spinach,	100	" 2 tbsp.		2.10	4.10	2.60	57	
(with) butter,	15	" 1 ball.		0.15	12.75		119	
Dessert made from egg,	50	" 1 ave.		6.70	5.25		76	
(and) cream, (aver.),	40	" 2 tbsp.		1.48	10.28	1.42	108	929
Afternoon Tea:								
Tea								
(with) cream,	20	gm., 1 tbsp.		0.74	5.14	0.71	54	54

* Modified from Janeway (30).
Caloric values after Locke (41).

TABLE XI—Continued

Meals, Articles, Amounts, Rough Measure	Protein	Fat	Carbo- hydrate	Calories	Total
Dinner:	Grams	Grams	Grams		
Consommé, 120 gm., cupful.	3.00	.....	0.48	14	
Mackerel, fresh, 100 " portion.	21.80	5.90	.....	144	
(with) butter, 15 " 1 ball.	0.15	12.75	.....	119	
Mutton (roast leg), 75 " 1 slice	18.75	16.95	.....	234	
Asparagus, 125 "	1.88	0.13	3.50	23	
(with) butter, 15 " ball	0.15	12.75	.....	119	
Lettuce, 50 "	0.60	0.15	1.45	10	
(with) olive oil, 13 " 1 tbsp.	.....	13.00	.....	121	
Cheese (pineapple, e.g.), 20 " 2 scoops	5.98	7.78	0.52	99	
Demi-tasse of coffee .....	.....	.....	.....	.....	883
137 × 4.1 = 561	137	220	12		2,645
220 × 9.3 = 2,046 .....	.....	.....	.....	.....	.....
12 × 4.1 = 49 .....	.....	.....	.....	.....	.....
2,656					

In *moderately severe* cases we would proceed at first as in the mild cases, placing the patient on the standard diet under which he would probably become sugar-free after several days. As his tolerance for carbohydrates is exceedingly small or nil, the diet has to be kept up longer than in mild cases. In so doing the physician must bear in mind the possibility of the development of acidosis, and if that occurs it is well to introduce a little carbohydrate into the dietary, or to proceed as indicated for severe cases. Indeed, the dividing line between this group and the next cannot be sharply drawn; however, if acidosis does not occur we may carefully feel our way by first adding half a slice of bread. If sugar does not appear it is evident that the tolerance has been slightly raised, and we continue this minimum amount of carbohydrate, preferably as bread, for ten days or two weeks before attempting any further addition. If sugar does appear it is best to reduce the proteids and to increase the fats, as in severe cases. In such an eventuality the table of restricted protein (Table XII) may serve as a basis and guide.

In *severe* cases the treatment would be initiated as in the others. As, however, the total exclusion of the carbohydrates from the diet does not render the patient sugar-free, it is necessary to lessen the protein intake materially and to increase the fats correspondingly. By substituting for meat protein some vegetable protein¹ or egg albumin, both of which seem to produce less sugar than meat, a reduction in the sugar output

¹Several proprietary articles said to consist of vegetable protein are on the market. They have been especially recommended by German writers.

may be brought about. It is in this group that the caloric value of the daily ration must be watched, as the patient rapidly loses weight if the caloric intake is allowed to fall too low. What simple diet restriction fails to do is sometimes accomplished by the judicious interpolation of von Noorden's "green days" or Naunyn's "starvation day," or several oatmeal days.

TABLE XII
*Standard Diet—Restricted Protein**

Modified from Standard Diet	Protein	Fat	Carbohydrate	Calories
<i>Omit</i>	Grams	Grams	Grams	
Breakfast:				
Ham.....	23.31	34.86	.....	400
Luncheon:				
One-half steak.....	11.75	10.20	.....	143
Dinner:				
Mackerel.....	21.80	5.90	.....	144
	56.86	50.96	.....	687
<i>Add</i>				
Breakfast:				
Bacon, 60 grams.....	6.30	38.88	.....	388
Net reduction.....	50.56	12.08	.....	299
This gives the Standard Strict Diet with Restricted Protein.....	87	208	12	2,346

* In either list alternatives may be substituted.

Oatmeal Treatment.—The oatmeal treatment, introduced into the dietotherapy of diabetes by von Noorden, accomplishes good results in certain types and stages of the disease. Very little is known as to its real mode of action. The results are better than those that have been obtained with the rice diet of Duering, the potato diet of Mossé, or the milk cure of Donkin. The sugar assimilation seems to be better when only a single type of carbohydrate is offered to the system than when a variety of starches is ingested at the same time. Magnus-Levy (45) has shown that the active substance in the oatmeal is the oat starch, and believes that the good results are due to fermentation of this starch in the intestines, the absorbed fermentative products either being oxidized in place of sugar or acting as stimulants to sugar combustion. Von Noorden thinks that oatmeal has a specific effect on the carbohydrate metabolism in the liver. Naunyn denies that the diabetic possesses an elective tolerance for oatmeal, holding that the good effects are due to fermentative products formed from the oatmeal in the intestines. Blum (7) found that equally good results could be obtained with wheat flour as with oatmeal, provided the treatment was preceded by several vegetable days and that no meat was given with the wheat flour. He found wheat and oatmeal better as-

simulated the better the general condition of the patient. In his opinion the better assimilation is due to the diminution of the hyperglycemia brought about by the preliminary vegetable days. The lessening of the hyperglycemia increases sugar combustion.

The addition of meat to the oatmeal diet lessens its usefulness, since meat, according to Blum, has an unfavorable influence upon the oxidation of carbohydrates. Vegetable albumin (Blum, *loc. cit.*) inhibits sugar combustion in a somewhat lesser degree than meat.

The oatmeal treatment is applicable to all cases of acidosis and to severe cases of diabetes in which the exclusion of carbohydrates and protein restriction fail to render the urine sugar-free. As I have said before, a few days of oatmeal treatment may in severe cases help to render the urine aglycosuric. At times no results are seen under the first oatmeal treatment of three or four days, and a second and a third may then have to be instituted (Lampé, 32). In the majority of cases a coexisting ketonuria is diminished. The following table, Table XIII, shows the caloric value of the oatmeal diet. In addition to oatmeal and butter, black coffee, tea, lemon juice, and a little red wine may be allowed. The best results with oatmeal seem to be achieved when the treatment is preceded by one or two vegetable or green days.

It is rarely possible to continue the monotonous oatmeal diet for more than three or four days at a time; some patients will not take it that long. Another objection to it is that it sets up fermentation with flatulence, and either constipation or diarrhea. The reluctance of the patient may often be overcome by informing him of the good effects likely to follow persistence in the treatment.

As a substitute for oatmeal Klemperer (31) has recently used glucose, giving it under the same conditions and restrictions as oatmeal. From 100 to 150 grams of grape sugar were administered in an equal amount of water. It was found that when meat was withheld, and after preliminary vegetable days, the glucose was assimilated in considerable quantities; but from the statistical data given one is impressed with the fact that the method is not superior, perhaps not even equal, to the oatmeal diet.

TABLE XIII

Oatmeal Diet

	Protein	Fat	Carbo- hydrate	Calories	Total
	Grams	Grams	Grams		
Butter, 150 grams (5 ounces).....	1.5	127.5	.....	1,190	
Oatmeal (rolled oats), 300 gms. (10-11 oz.)	50.1	21.9	198.6	1,224	
	51	149	199		
Calories.....	213	1,385	816	.....	2,414

The oatmeal is put into 3 pints of water, slightly salted, and thoroughly cooked for at least 6 hours, and, while still hot, strained. The butter is then added and stirred in. It is usually taken in 7-ounce feedings at 2-hour intervals, and may be used three or four days or longer.

TABLE XIV

Green Day

	Protein	Fat	Carbo- hydrate	Calories	Totals
Breakfast:	Grams	Grams	Grams		
1 egg (boiled or poached), 50 grams.....	6.70	5.25	.....	76	76
Cup of black coffee.....	.....	.....	.....	.....
Dinner:					
Spinach, 100 grams, 2 tbsp.....	2.10	4.10	2.60	57	361
(with) 1 egg (hard boiled), 50 grams.....	6.70	5.25	.....	76	
Bacon, 15 grams, ½ slice.....	1.57	9.72	.....	97	
Lettuce, 50 grams.....	0.60	0.15	1.45	10	
(with) olive oil, 13 grams, 1 tbsp.....	.....	13.00	.....	121	
Afternoon:					
Bouillon, 120 grams, 1 cup.....	2.64	0.12	0.24	13	13
Supper:					
1 egg scrambled.....	6.70	5.25	.....	76	255
(with) butter, 7½ grams, ½ ball.....	0.07	6.37	.....	59	
Bacon, 15 grams, ½ slice.....	1.57	9.72	.....	97	
Asparagus, 125 grams.....	1.88	0.13	3.50	23	
Cup of tea.....	30.53	59.06	7.79	.....	705
Calories.....	125	549	28		

One-half ounce sodium bicarbonate in twenty-four hours should be given in conjunction with the "green day."

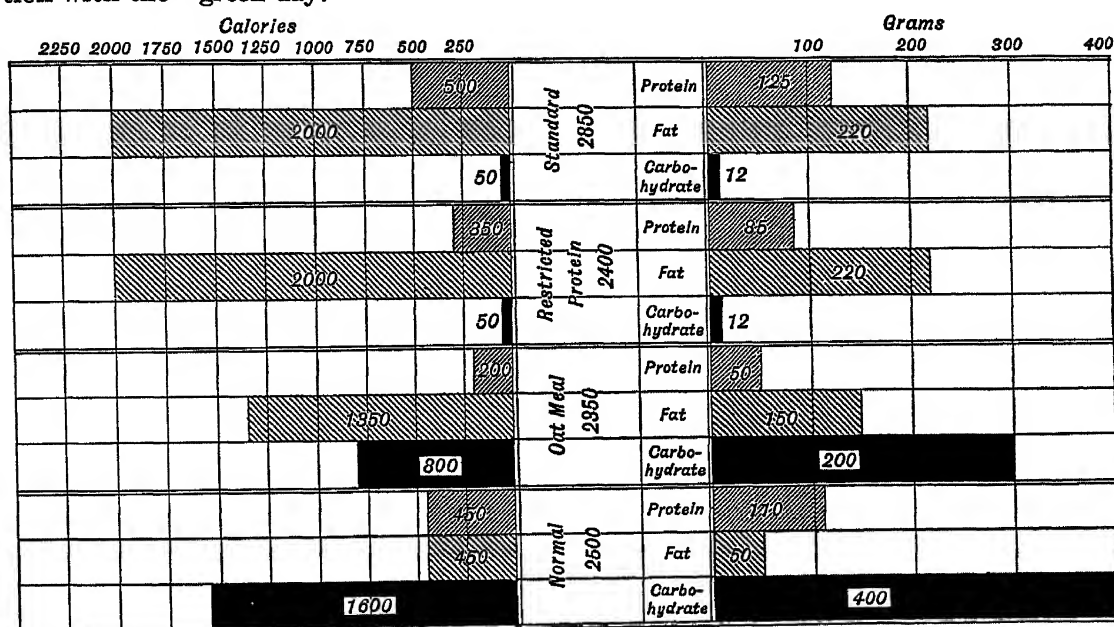


FIG. 5.—ILLUSTRATING THE QUANTITATIVE RELATIONS AND THE CALORIC VALUES OF THE NORMAL AND OF VARIOUS DIABETIC DIETS

Green Days.—The advantage of the vegetable or green day, which in its caloric value is almost equivalent to a starvation day, is that it gives a rest to all metabolic functions. It raises the tolerance for sugars made from protein, which is greatly deficient or totally lost in cases of acidosis, and lessens the hyperglycemia, but as it involves a caloric intake far below the minimum requirements, it cannot be safely continued for more than two days. A specimen green day is given in Table XIV.

TREATMENT OF ACIDOSIS

The treatment of acidosis will depend somewhat upon the previous history of the case. If the patient has been under competent observation and has developed ketonuria on a strict diet he needs carbohydrates. In some instances the addition of milk, a little white bread, or a starch-containing vegetable may lessen the acidosis, though it may at the same time increase the glycosuria. Sodium bicarbonate should be given, 15 grams ($\frac{1}{2}$ ounce) a day, or even more if the urine remains strongly acid. For part of the sodium bicarbonate sodium citrate may be substituted. It is interesting to remember in this connection that normal urine may be rendered alkaline with 2 grams of sodium bicarbonate, while in some cases of diabetes it may take 50 to 100 grams.

If under the measures just mentioned the acidosis continues the patient should be put on a restricted protein intake, and from time to time the oatmeal treatment should be instituted, always preceded by one or two vegetable or green days.

If the patient comes to us *de novo* with acidosis, having lived on an ordinary mixed diet—and these cases are common—any sudden radical change is unwise. The carbohydrates should be withdrawn gradually from the diet; not infrequently their slow but total withdrawal is followed by a disappearance of the ketonuria. This does not disprove the generally accepted theory that ketonuria develops only in the absence of carbohydrates. The disappearance of the ketonuria when no carbohydrate is given is due to the fact that through the reduction of the carbohydrate intake the tolerance for them is raised, the large amounts of carbohydrates previously taken in not having been utilized by the system.

If the patient's urine after the use of the restricted diet continues to give a strong ferric chlorid reaction, then one must proceed with protein restriction, oatmeal days, and vegetable days, as described above.

The sodium bicarbonate or citrate seems to lessen the acidosis by making the ketones available for elimination by the kidney, not by increasing the oxidation of the fats. Food fat in all probability is not a source of ketones, but only the body fat and perhaps certain amino acids derived from protein. Butter, however, contains butyric acid, which

distinctly increases ketonuria. This acid may be and should be removed from butter by washing.

In the acidosis of children Langstein (33) recommends fat-poor buttermilk.

Many efforts have been made to find substances that prevent acidosis—so-called antiketogenic or antiketoplastic substances—but without much success. Mannite (Hirschfeld, 24), xylose (Mohr and Loeb, 52), inosite, glycerin, and glycuric acid (Baer and Blum, 4) have been recommended. Naunyn and von Noorden speak well of levulose.

Alcohol, though it has no power to reduce ketonuria in healthy persons on a carbohydrate-free diet, certainly lessens the ketonuria of diabetes.

A patient with ketonuria should be kept under constant observation. After acidosis has disappeared he should continue the use of alkalies for a long period. Loenig (38) reports the case of a boy of eleven who under a strict diet and the use of sodium bicarbonate had become sugar-free. He continued to take the bicarbonate of soda for some time and then, contrary to instructions, discontinued it. Two or three days later he became comatose and despite the energetic introduction of alkalies succumbed.

TREATMENT OF DIABETIC COMA

The treatment of diabetic coma must be prompt, energetic, and intelligent. As soon as the diagnosis is made the effort to saturate the patient with alkalies must be begun. Sodium bicarbonate should be given by the mouth if the patient can swallow (teaspoonful every three hours), or by the rectum, 50 grams (2 oz.). If the rectal route is used the solution may be given *en masse* or by the Murphy drip method; in the latter case it should be kept warm constantly. It may also be given intravenously, $\frac{1}{2}$ to 1 liter of a 5 per cent. solution being thrown directly into a vein, preferably after a preliminary bleeding. The amount of blood to be withdrawn will vary with the blood pressure. If that is high, as it usually is in elderly diabetics, 300-500 c. c. may be taken, the sodium bicarbonate injection being made into the upper end of the divided vein. The infusion may be repeated at the end of six hours.

Instead of the bicarbonate the citrate of sodium, as recommended by Lichtwitz (36), may be employed for oral administration.

Nitroglycerin, 0.0006-0.001 (1-100 to 1-50 grain), is useful if the pressure is elevated. Oxygen in my experience has not relieved the air-hunger, but it is a remedial measure one is sometimes forced to use. The bowels must be thoroughly moved without delay by high enemas of saline solution to which Epsom salts (30 grams, or 1 oz.), or glycerin (15 grams, or $\frac{1}{2}$ oz.) may be added. Naunyn and von Noorden recommend

subcutaneous injections of levulose or dextrose for their antiketoplastic effect.

Sometimes the urine output diminishes markedly with the onset of coma, the sugar and ketones also showing a decrease. Albumin and casts are very common and indicate a high degree of toxemia. Diminution in the quantity of urine may, however, be only apparent, for retention is not infrequent; hence the bladder region should always be percussed in cases of coma.

Prognosis of Diabetic Coma.—Recovery is exceptional, but not impossible. Sometimes consciousness returns during the progress of the alkaline infusion, but one must be extremely cautious about declaring the patient out of danger—only too frequently the coma returns and passes into death. The earlier the treatment with alkalis is undertaken the better the outlook. Not infrequently the patient has been taking alkalis for some time, yet coma develops. This probably signifies that the quantity of alkali was inadequate to the degree of acidosis.

After recovery from impending or actual coma it is best to put the patient on the oatmeal diet and to carry out the treatment as prescribed for severe cases. The alkalis should of course be continued for a long time.

SUMMARY OF DIETETIC TREATMENT

MILD CASES.—Render patient sugar-free by use of restricted diet, of which Table XI is a specimen. This may take from a few days to two weeks. Then test tolerance by adding a weighed amount of bread. Give two-thirds of amount tolerated, either as bread or as an equivalent, using Table III. After several months retest the tolerance, increasing or decreasing the carbohydrates according to the condition of the urine.

MODERATELY SEVERE CASES.—Render patient sugar-free by restricted diet (see Table XI). Continue this, watching carefully for acidosis and controlling the patient's weight. From time to time test tolerance by giving a small amount of carbohydrate.

SEVERE CASES.—These cannot be rendered sugar-free by excluding the carbohydrates alone; the protein also must be restricted. Reduce the protein intake to eighty or sixty grams per day or even less, and increase the fats correspondingly. Table XII will serve as a guide. The interpolation of one or two green days (see Table XIV) is useful.

GRAVE CASES.—The urine cannot be rendered sugar-free by excluding the carbohydrates and reducing the protein. Place patient on vegetable diet for one or two days, then on oatmeal diet for four days. Give sodium bicarbonate in doses of 4 to 8 grams (1 to 2 drams) three times a day. Repeat treatment from time to time.

DRUGS IN DIABETES

The curability of a disease is usually in inverse ratio to the number of remedies suggested for it. In a work on therapeutics on my desk I find forty-three drugs and preparations recommended for diabetes. Those who have had the largest experience with the disease have the least faith in the power of drugs to cure it. The manufacturers of proprietary preparations often make extravagant claims that are not borne out by tests on large series of cases. Success during the administration of a remedy does not prove that the remedy brought about the good result, but may be due to adherence to a correct dietetic regimen, which the literature accompanying proprietary remedies often enjoins. In the following paragraphs I will mention a few of the drugs that have been employed in diabetes, and which in certain instances may do good.

Opium is one of the oldest remedies in diabetes. It seems to lessen the excretion of sugar and perhaps slightly to increase the toleration for carbohydrates. It is especially useful to assist in driving final traces of sugar out of the urine, but it must be given in large doses, which diabetic patients seem to bear very well. The dose of powdered opium (*pulvis opii*) is 0.06 to 0.18 gram (one to three grains) three times a day. Instead of opium *codein* may be employed, though it is questionable whether it possesses all the properties of opium; but it has the advantage of being easily administered and being less constipating than the parent substance. It is used in doses of 0.015 to 0.06 gram ($\frac{1}{4}$ to 1 grain) three times a day.

Quite recently *pantopon*, which is supposed to represent all the alkaloïds of opium, has been introduced into the therapy of diabetes. It is given in doses of 0.02 to 0.06 gram ($\frac{1}{3}$ to 1 grain) three times a day.

Arsenic.—The use of arsenic in diabetes is purely empirical, and the evidence of its efficacy slight. Von Noorden (*loc. cit.*) in two instances had apparently brilliant results with hypodermic injections of sodium arsenate. In eight other cases the remedy failed entirely. Sodium cacodylate has also been recommended (Renaut, 64). It may be given hypodermically in doses of from 0.015 to 0.12 gram ($\frac{1}{2}$ to 2 grains).

[My own experience causes me to look upon arsenic as a very valuable remedy in diabetes mellitus. Especially is this the case in the second degree of diabetes in which diet plus arsenic may cause the glycosuria to disappear temporarily when dieting alone fails to do so. It should be given in ascending doses, until some of the physiological effects are produced and then gradually withdrawn.—EDITOR.]

Atropin.—Rudisch (68) and Forchheimer (16) have claimed that atropin increases carbohydrate tolerance. Usually atropin sulphate has been employed, sometimes atropin methyl-bromid. My own experience

with both of these salts has been as unsatisfactory as that of Mosenthal (56), who in a careful study of two cases found atropin sulphate to have no value.

Magnesium Perhydrol.—Rather strong claims have been made for this preparation. Axenberger (3) found that the sugar elimination, the quantity, and the specific gravity of the urine were greatly reduced. The reaction soon became neutral or feebly alkaline, and an existing acidosis disappeared. Stuermer (76), with a special diet, claims to have secured a reduction in sugar elimination by means of magnesium perhydrol. The drug is used in doses of 0.5 gram ($7\frac{1}{2}$ grains) three times a day.

The *salicylates* are much employed in diabetes—in the form either of sodium salicylate, 0.3-0.8 gram (5 to 10 grains), or of aspirin in the same doses. While they have no power to do the slightest good independently of dietetic treatment, patients with a certain degree of tolerance (60 to 150 grams bread) often have their tolerance raised while taking them.

Eserin.—Eserin has been used in the belief that as a stimulant to the vagus nerve it would exercise some influence on the organs concerned in the carbohydrate metabolism, but no good effects have been obtained with it. It is a constituent of the valueless proprietary preparation called Diabeteserin.

Lithium carbonate and *lithium citrate* have been used in the diabetes of persons having a gouty taint. The dose is 0.5 gram ($7\frac{1}{2}$ grains).

Uranium nitrate has been given in diabetes. It is capable of reducing the glycosuria, but it accomplishes this, in all probability, by irritating the kidneys and lessening their permeability for sugar.

Syzygium Jambulanum.—Without a regulation of the diet jambul, employed in the form of an infusion of the dried fruit, is useless. With a restricted diet von Noorden found it in a few instances to lessen the sugar output to the extent of from 15 to 20 grams per day. The drug is, however, now seldom used.

Organic Extracts. Opothrapy.—The experiments of von Mering and Minkowski, showing that pancreatectomy in dogs is followed by diabetes, and the pathological studies of the pancreas in human diabetes have led to the use of dry and fresh pancreas and pancreatic extracts in the treatment of the disease. The results have been disappointing. It is highly probable that the pancreatic ferments and the obscure internal secretion if they exist in the dead gland at all are destroyed by gastric digestion. With this thought in mind I have prescribed pancreatic extract in the so-called glutoid capsules without obtaining any influence on the glycosuria. In only one instance have I seen distinct benefit from pancreatic extract. The patient was a middle-aged diabetic suffering from frequent attacks of pain in the upper abdomen. There were no definite signs pointing to any special organ, but their location led me to suspect that the pain was of pancreatic origin. It was not severe enough to sug-

gest stone. Under the use of pancreatic extract in five-grain doses three times a day the pain invariably subsided very shortly.

A few years ago Zuelzer (81) recommended a "hormone" extracted from the pancreas. It is administered intravenously. Subsequent experimenters (Forschbach, 17) found that the substance produced a pronounced febrile reaction with alarming symptoms of prostration, and warned against its use.

Sewall (72a), using the work of Cohnheim as a basis, employed combined infusion of beef and pancreas as well as beef juice alone in the treatment of diabetes. The beef juice is prepared as follows: One pound of lean beef is ground in a sausage machine, then covered with a pint of cold water to which thirty drops of dilute hydrochloric acid are added. The mixture is allowed to stand in the ice box all night or at room temperature four hours, and is then strained through cheese cloth. The liquid should be drunk in the course of a day, one-half to one tumblerful at a time.

The mixed beef and pancreas infusion is prepared in the following way: Six ounces of ground fresh pancreas are soaked all night in a quart of water acidulated with a dram of dilute hydrochloric acid. After straining a pound of ground beef is added to the fluid. After remaining at room temperature for four hours, the mixture is again strained and the juice then consumed by the patient in the course of twenty-four hours.

Sewall found the acidulated beef infusion to be of some value in the diabetes of the aged. Barring temporary benefit in a single case, the combined pancreas and beef infusion had no noticeable effects.

Secretin.—This is a substance prepared by extracting duodenal mucosa. It has been used in diabetes, chiefly in England. The results have not been encouraging (Bainbridge and Badderd, 5), although Moore, Eddy, and Abram (13, 55) report good effects. *A priori* one would hardly expect secretin to be of any value, since it is a hormone stimulating the external secretion of the pancreas.

Yeast.—Yeast has been recommended on the ground that its ferment zymase is glycolytic and breaks up the sugar into intermediary compounds which the diabetic is able to utilize. It is a question, however, whether the sugar decomposes in the body in the same manner as in the test tube. Nor is it known whether the enzyme unfolds its activity only in the alimentary canal or whether it can act on the sugar after absorption. Aside from the ordinary brewer's yeast various yeast extracts have been employed in the treatment of diabetes. These extracts are largely of proprietary nature and need not be mentioned here. One of the proprietary ones is highly praised by Seemann (72), but when his figures are studied the results are by no means striking. Fränkel (19) found tablets prepared from yeast zymase useful in diabetes.

Trypsogen.—This is a substance prepared from the tails of the pancreatic glands of young animals. It is claimed by the makers that it contains the “enzymes of the islands of Langerhans, the tryptic, amylolytic ferments.” The tablets on the market also contain gold bromid, .01 grain, and arsenic bromid, .02 grain. The dose is from two to eight tablets, three times a day. The manufacturers state that trypsin has the same action as Zuelzer’s pancreatic hormone, concerning the utility of which there is, however, grave doubt. Aside from the fact that little if anything is known regarding the ferments of the islands of Langerhans in contradistinction to those of the acini, it is doubtful whether the enzymes present in the preparation, and which act only in alkaline media, can withstand the action of the acid gastric juice.

Lactic Acid Bacilli.—Lactic acid bacilli have been recommended for nearly every ill that flesh is heir to, including diabetes (Horowitz, 25). The drug manufacturers have not been slow in seizing the psychological moment and putting upon the market innumerable preparations containing various strains of these bacilli. Quite recently the Bulgarian bacillus has been proposed as a remedy for diabetes, but so far no scientific study of the subject has appeared; moreover, it is *a priori* unlikely that it will have any special virtue in the curing of the disease.

HYDROTHERAPY

The ordinary bathing to which the patient is accustomed may be continued without change except in the case of cold plunges. In the diabetic who is losing weight cold bathing is not only a shock to the system, but brings about an unnecessary increase in the energy requirement. Cold sponging suffices, and even that is inadvisable when there are acidosis and rapid emaciation. Diabetic patients with strongly marked neurasthenia—a frequent occurrence—are benefited by warm, prolonged bathing either in plain water or in water charged with carbon dioxid. Sea bathing is not an indifferent procedure for diabetes and the question of its advisability must be carefully weighed in every case. Those that are highly neurasthenic ought to abstain from it, for they become quickly fatigued and depressed after an ocean bath. For a robust diabetic, in weight equilibrium, a short ocean bath is probably not harmful.

HEALTH RESORTS FOR DIABETICS

A number of places, chiefly on the continent of Europe, enjoy a reputation in the treatment of diabetes. It is an open question whether there is anything in the climate, in the baths, or in the drinking water of any of these resorts that has a particular influence on the disease; yet there

must be something in the treatment at Carlsbad, Neuenahr, Vichy, and other famous spas or diabetics would not go there year after year by the thousands. The good effects of Carlsbad, for example, cannot be disputed. And it has been the experience of a number of observers that they cannot be duplicated by drinking the Carlsbad waters at home, even if the temperature of the water is raised to that of the springs. The quiet, peaceful life, beautiful scenery, and well-prepared food are no doubt factors in the good effects. Another very important thing is the knowledge of the disease and its dietetic treatment possessed by the physicians in Carlsbad and other places much frequented by diabetics. Whether the presence of radioactive emanations, as is claimed by some Carlsbad physicians, plays a therapeutic rôle is still an unsettled question.

In the diabetes of childhood and advanced age but little benefit is to be derived from watering places. Carlsbad and Marienbad are certainly contraindicated. Good results may at times be obtained at Neuenahr, Vichy, and Homburg. A tendency to diarrhea contraindicates Carlsbad, Kissingen, and Homburg. No patient in a state of rapid emaciation should be sent to a spa. When there is marked albuminuria Marienbad and Carlsbad are not suitable. Neuenahr, Vichy, Homburg, and Wiesbaden are better under such circumstances. Cardiovascular disease contraindicates Carlsbad, Vichy, and Neuenahr. Benefit may be derived from hydrotherapeutic treatment at Homburg, Kissingen, Marienbad, and Nauheim. Anemia contraindicates Carlsbad and Neuenahr. For such cases von Noorden recommends ferruginous baths and elevated climate. Old persons do better in the warm seashore resorts in the winter; in this country Florida, Southern California, and even Atlantic City for short sojourns; in Europe the Riviera. For children and young adults strong drink cures are not to be employed; sea baths, salt baths, and altitude resorts are best adapted.

EXERCISE IN DIABETES

The treatment of diabetes with muscular exercise is based on the investigations of Külz and von Mering, who showed experimentally that muscular movements diminish sugar elimination. Previous to Külz, Trousseau and Bouchardat had shown the same thing by clinical observation. Exercises are indicated for mild cases and should take the form of walking, mountain climbing, dumb-bell and Indian-club practice, mild tennis, and bowling. Horseback riding is also beneficial, especially for those with sedentary occupations. The effect of massage is analogous to that of muscular work. In severe cases, especially in those with acetoneuria, active exercise is contraindicated.

TEMPERATURE

Lüthje (41) found in a diabetic dog that a low external temperature lessened and a high external temperature raised sugar combustion. The direct application of this in practice is not possible, but Benedict and Joslin (6) advise that in bad cases of diabetes with emaciation the water the patient drinks should be previously warmed. They write as follows:

"For example, if three liters of water are taken and excreted as urine in the course of the day, this water is warmed from an average of 10° C. to the temperature of the body, 37° C. In other words, each liter is warmed 27° C., and 3 liters so warmed would result in the absorption of 81 calories. With a body weight of but 42 kilograms, a weight not uncommon with many diabetics, this may be nearly 6 per cent. of the total heat of a day, an amount that cannot be neglected when practically every calorie must be taken into consideration in attempting to keep up the unequal fight of increased metabolism on the one hand and deficient utilization of carbohydrates on the other."

TREATMENT OF SPECIAL SYMPTOMS

Itching.—This is sometimes intolerable. If the itching is in the region of the vulva, anus, or scrotum the skill of the physician is often taxed to its limit to provide relief. I have seen a case of pruritus of the scrotum of such intensity that the patient harbored thoughts of suicide. If the itching is general relief may at times be obtained from prolonged warm soda baths containing from four to five ounces of washing soda to twenty gallons of water. In some cases the addition of a pound of starch may add to the soothing qualities of the bath. Of local applications, those containing phenol, menthol, or thymol may be employed. Phenol may be used in the strength of 4.0-8.0 gm. (one or two drams) to the pint of water, menthol in strengths of 2.0-3.0 gm. to 500 c. c. (thirty to forty-five grains to the pint) with a little alcohol and glycerin. Ammonia water of moderate strength is also useful. Crocker advises the following:

R

Thymol, 15 gm. (3iv).

Liq. potassæ, 8 gm. (3ii).

Glycerin, 24.0 c. c. (3vi).

Water q. s. ad 500 c. c. (one pint)

M. S.—Local use.

I have seen benefit from the calamine lotion. When the skin is dry and scaly ointments are preferable to lotions. The following is recommended by Schamberg (68a):

R

Menthol, 0.8-1.3 (gr. x-xx).

Pulv. camphoræ, 1.3-2.0 (gr. xx-xxx).

Phenol, 1.3-2.0 (gr. xx-xxx).

Adipis benzoat., 60. (℥ii).

M. S.—Local use.

Aside from the measures just mentioned I have found in one instance that an obstinate pruritus vulvæ disappeared on the application of brewer's yeast. In pruritus of the scrotum a well-fitting suspensory should be worn. In pruritus ani an ointment of calomel, twenty grains to the ounce of petrolatum, or cold cream, or one of phenol, may be used. The brilliant results achieved by the X-ray in dermatology justify a trial of it in the local forms of pruritus met with in diabetes, especially in pruritus vulvæ.

Boils.—Boils are quite frequent in young and middle-aged diabetics. Occasionally one meets an individual whose urine is free from sugar during a siege of boils, but gives the glucose test soon afterward. The local treatment consists in the use of Bier's hyperemia cup and, failing in this, in incising the boil as soon as evidences of suppuration are present. If the boil is very painful and shows no sign of coming to a head, one of the best applications is a flaxseed poultice made with a one to two thousand bichlorid of mercury solution. The internal administration of brewer's yeast in doses of one or two teaspoonfuls three times a day has been much used in the treatment of boils. Various extracts of yeast are on the market, designed to obviate the disagreeableness of the native remedy. If the boils persist in spite of antidiabetic and other forms of treatment, recourse may be had to the use of vaccines, the autogenous vaccines being the best.

Sodium phosphate and sodium arsenate have been recommended as useful in the preventive treatment of boils in diabetes.

Xanthoma Diabeticorum.—This skin affection, first described by Crocker, is most common in young adults; it is not of serious moment and usually yields to ordinary antidiabetic treatment.

Diabetic Vulvitis.—Cleanliness, douching several times daily with hot salt solution, and afterwards drying the parts carefully with a soft towel constitute the treatment of this condition. Vaginal irrigation once daily with a solution of corrosive sublimate, one to two thousand; creolin, 1 per cent., followed by an ointment of salicylic acid, ten grains to one ounce petrolatum; or dusting powders, equal amounts of calomel and bismuth subnitrate or oxid of zinc may be prescribed. Excoriations and abrasions should be painted occasionally with nitrate of silver, 1.5 to 30 c. c. (twenty grains to the ounce); benzoated oxid of zinc ointment containing 3 per cent. of phenol, or an

ointment of petrolatum containing 20 per cent. oxid of zinc may then be applied.

Diabetic Neuritis and Neuralgia.—Neuralgia involving the trifacial nerve, either all the branches or only one of them, most often the dental, is not infrequent in diabetes. The presence of such a cause should therefore be borne in mind and the urine examined in all cases of neuralgia. The principal aim should be the lessening of the hyperglycemia by diet. For the attack the various anodynes, such as antipyrin, 0.3 to 0.7 gm. (five to ten grains), acetphenetidin, 0.3 to 1.0 gm. (five to fifteen grains), pyramidon, 0.3 to 0.5 gm. (three to seven and a half grains), etc., may be used; or the high frequency current, and in rebellious cases alcohol injections.

Excision of the Gasserian ganglion is such a formidable operation even in nondiabetic subjects that it is only justifiable in extreme cases and under full realization of the danger of coma.

Sciatic Pain.—Pain in the course of the sciatic nerve is very common in diabetes. It is usually bilateral. It may affect the entire nerve or may be referred particularly to the calf. In all cases of bilateral sciatic pain the urine should be examined for sugar. Sometimes the symptoms are suggestive of locomotor ataxia, the pains being of a lightning-like character, the knee-jerk being at the same time absent.

Here, too, the principal treatment is that of the diabetes; in addition rest in bed and one of the various coal-tar preparations of which several have been mentioned above. In severe cases I have thought that some relief was obtained from methylene blue, given in pill form in doses of 0.06 gm. (one grain), usually with a little extract of belladonna, 0.005 gm. (1-12 grain).

Brachial Neuritis.—This, painful enough under ordinary circumstances, becomes a terrible torture in diabetic patients. It is usually unilateral, but may be bilateral.

Proper diet must be instituted and the patient must have mental rest, sometimes even physical rest. Hot applications in the form of hot wet compresses are eminently useful. In recalcitrant cases a trip to Carlsbad may be devised.

Impotence.—This may be a very early symptom of diabetes. As a general rule, the prognosis for restoration of function is not good. Drugs have little value if antidiabetic diet fails. I have seen no benefit from the much vaunted yohimbin.

Prostatic Disease.—This complication, to which Heinrich Stern (74) has called special attention, is not common, but should nevertheless be recognized. It will not improve under local therapy unless proper antidiabetic treatment is applied. The prostatic symptom-complex may occur much earlier in the diabetic than in the normal individual.

Diabetic Eye Affections.—The most important are cataract and reti-

nitis. There seems to be no relation between the cataractous condition and the type of the diabetes, amount of sugar, or general state of the patient's health. In considering operation the danger of coma must be borne in mind.

Diabetic retinitis demands the general dietetic treatment and rest of the eyes.

Hemorrhages into the several parts of the eye—conjunctiva, vitreous, and sclerotic—occur; also various disturbances of refraction and accommodation—all must be treated jointly by the ophthalmologist and the clinician skilled in the dietetic treatment of the underlying disease.

DIABETES AND TUBERCULOSIS

Von Noorden found tuberculosis in 29 out of 252 cases of diabetes, or in about 12 per cent.; Williamson in 29 out of 100 consecutive cases; Montgomery in 138 out of 355 autopsies (38.9 per cent.).

On account of their tendency to tuberculosis it is important to shield diabetic patients with special care from infection. When the disease is once established treatment becomes very trying, for it is then doubly difficult to maintain the patient's nutrition. The diet must be watched and relaxed or varied in order to get the best results. Sanatorium treatment in a rigorous climate cannot be borne by the majority of such patients; a fairly warm, wind-sheltered climate must be chosen.

DIABETES AND THE THYROID GLAND

As has been previously stated, the thyroid gland has a share in carbohydrate metabolism by exercising an inhibitory influence on the pancreas. I believe, however, that the diabetogenic power of the thyroid has been overestimated. In my own experience the two diseases—diabetes and exophthalmic goiter—have been very rarely associated. I have also seen persons take large quantities of thyroid preparations without becoming either diabetic or glycosuric.

When the two diseases coexist treatment is complicated, for proteins, which are generally used in considerable quantity in diabetes, have an irritative effect on the thyroid gland. Moreover, surgical treatment of the goiter is rendered more dangerous by reason of the presence of diabetes. The X-ray has proved of some value in the treatment of thyrogenic diabetes. In many cases it has failed; and the success or failure of the treatment seems to depend upon whether the thyroid is or is not the chief factor in the diabetes. Schwarz (71) and Hirsch (22) have observed the disappearance of alimentary glycosuria under the use of the X-ray in Basedow's disease.

DIABETES AND SYPHILIS

As a cause of diabetes syphilis occupies a very unimportant place. It may be met as an accompanying disease, the infection taking place either before or after the diabetes has appeared. The important point to remember is that there is danger in mercurial treatment; for not alone is stomatitis, if it occurs, likely to take a severe form, but gangrene may ensue, and if tuberculosis exists it may take a more rapid course. (Falta, 14.) It may therefore be advisable, in otherwise suitable cases, to use salvarsan by the intravenous method. If mercury is employed its effects should be carefully watched.

DIABETES IN PREGNANCY

Felix Hirschfeld (23) finds that diabetes not rarely gets worse in the third or fourth month of pregnancy, the acidosis being more affected than the glycosuria. Nevertheless, neither during pregnancy nor during the puerperium is coma likely to occur. In general the prognosis is relatively good, especially as the scant diet after labor may bring about a disappearance of the sugar. About ten per cent. of pregnant, nondiabetic women show glycosuria during pregnancy, either by reason of a predisposition to diabetes or because of nervous disturbances. Hirschfeld is inclined to look upon these glycosurias, as well as upon alimentary glycosuria in pregnancy, as an expression of a mild diabetic disorder of metabolism. It is mild even if diacetic acid transiently appears.

DIABETES IN CHILDREN

The treatment of diabetes in children does not differ materially from that in adults; the only important difference is that a strictly carbohydrate-free diet can rarely if ever be carried out without incurring the risk of coma, or at least of a marked increase in acidosis. Oatmeal, cream, fruits, and vegetables are especially valuable. Use must also be made of the more reliable diabetic breads and biscuits. The children should be taken from school; energetic playing must be forbidden. During the summer the seashore is more suitable than the mountains.

DIABETOPHOBIA

A morbid fear of diabetes is easily roused in many intelligent persons, especially those in whose families diabetes has existed. The physician should be careful in expressing an opinion until he has assured

himself that the reducing substance in the urine is sugar and, as already stated, before declaring a patient diabetic he should make sure that the glucose found is not due to an inordinate intake of sugar. I have in mind a young man who has become morbid over a disease which is in a very mild form, because a medical friend of his made the remark that young diabetics were sure to die early of their disease.

MAY DIABETICS MARRY?

Young persons with pronounced diabetes ought not to marry, as the duration of life for them is, as a rule, not long. It is probable that the nervous excitement attending a honeymoon as well as the difficulty in carrying out the proper regimen increases the danger of acidosis and coma. Moreover, diabetes may lead to early sterility and impotence.

SURGICAL OPERATIONS IN DIABETIC PATIENTS

The exaggerated fear of clinicians and surgeons of operations on diabetic patients is rapidly giving place to a more aggressive attitude; one recent writer goes so far as to say that the indications for surgical interference in the diabetic are not materially different from those in the nondiabetic. I am, however, of the opinion that all operations that can be avoided in diabetic subjects should be avoided, especially those requiring general anesthesia. Narcosis merely for diagnostic purposes is not justified. Confronted with an emergency such as strangulation of the bowels, acute appendicitis, severe injuries, etc., the same course should be pursued as if the patient were not diabetic. Preceding all operations that are not of an emergency character an attempt should be made to render the urine sugar-free. It is not absolutely necessary that the last trace of sugar should be banished before undertaking an operation that is important for the life or the comfort of the patient; particularly does this hold good if the patient's general health is satisfactory and if diacetic acid is absent from the urine. A diabetic woman under my care required an operation for an extensive perineal tear. When she entered the hospital her urine contained a large percentage of sugar. Under strict diet she became almost, but not quite, sugar-free. The operation was not followed by any untoward symptoms, recovery was prompt, pregnancy ensued, and a healthy child was born at term.

It is well to administer alkalis before an operation whether diacetic acid is or is not present in the urine. If there is acidosis the dangers of an operation are greatly enhanced, and unless it is of an emergency character the operation should be postponed and an effort made to lessen or

abolish the ketonuria. In addition to pushing the alkalies before and after operation a liter of a 5 per cent. solution of sodium bicarbonate should be introduced into a vein while the patient is still under the influence of the anesthetic.

The coexistence of arteriosclerosis with diabetes increases the hazard of an operation, as do all serious conditions affecting the heart and kidneys. On account of the liability to septic infection it is important to minimize tissue trauma. Ether is a safer anesthetic for the diabetic than chloroform, but whenever possible local anesthesia should be employed. Where a skilled anesthetizer and the necessary apparatus are available nitrous-oxid-oxygen anesthesia may be used even for prolonged operations. In proper hands spinal anesthesia is preferable to general narcosis. Operations requiring general anesthesia should be performed early in the morning, as protracted fasting before the operation may be harmful to the patient.

In local anesthesia too much fluid should not be introduced, as great tension of the tissues may lead to sloughing.

From a surgical point of view all cases having sugar in the urine, whatever the cause, should be looked upon as diabetic, and all of the precautions mentioned above should be taken. The glycosurias associated with injuries, especially cerebral injuries, usually disappear after operation. Nevertheless it is advisable, as recommended by Kausch (30), to make the alimentary test before the final discharge of such patients. If the response is positive the patient may become diabetic and should be kept under supervision.

Diabetic Gangrene.—Where the gangrene is dry and dependent largely upon arteriosclerosis the surgeon may wait for a line of demarcation, provided, however, the gangrene is not progressive. In moist gangrene any considerable delay is not advisable. If acidosis is present it must be actively treated, from 50 to 100 grams sodium bicarbonate being given in the twenty-four hours. Extract of opium, 0.03 gm. ($\frac{1}{2}$ grain), three times a day, may also be administered with advantage. Regarding the point of amputation, there is much difference of opinion. If the gangrene is in the foot, some writers (Umber, 78) advise exarticulation of the toe or a Pirogoff amputation of the foot, but the majority of surgeons operate high up in the leg. The X-ray or the Esmarch bandage test may be helpful in determining the site of arterial obstruction—amputation must be done above this point.

Several surgeons (Robson, 65; J. M. Hutcheson, 27) have suggested that cases of diabetes be submitted to surgical treatment, especially when a pancreatic origin of the disease seems likely. The following are Robson's conclusions:

1. The early recognition and treatment of interstitial pancreatitis or of pancreatic catarrh by drainage of the bile ducts and thus indirectly of

the pancreatic ducts and removal of the cause, whether that be gall stones, duodenal ulcer, or other conditions, may be the means of averting diabetes.

2. In certain diseases of the pancreas, even after the appearance of glycosuria, surgical treatment is well worth considering, as in a number of cases it has led to a complete disappearance of sugar from the urine and in others to an arrest of the disease causing glycosuria.

3. Every case of diabetes should be considered from its etiological point of view, seeing that certain cases of glycosuria of pancreatic origin are curable, and in others the progress of the disease may be arrested by suitable surgical methods that can be carried out with very small risk.

In my own experience there have been few cases in which either the history or the associated conditions suggested a definite disease in the pancreaticehepatic area.

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CHAPTER V

DIABETES INSIPIDUS

DAVID RIESMAN

Diabetes insipidus is a disease in which there is a permanent elimination of an excessively large quantity of sugar-free urine of low specific gravity without demonstrable lesion of the kidney. Two ways are conceivable in which the cardinal symptom of the disease may be brought about: there may be a primary polyuria with a secondary polydipsia or the reverse, a primary polydipsia with a consequential polyuria. In practice it may be difficult to determine to which type a given case belongs. There are undoubtedly cases in which the primary fault is an intense thirst—these are usually instances of functional nervous disease, hysteria, etc. Such patients pass large amounts of urine because they have acquired the habit of excessive water drinking. The other group, the primary polyurias, includes the majority of cases of diabetes insipidus. Here the fault is not excessive thirst, but inability on the part of the kidney to excrete a urine of proper concentration. Having lost the power of concentrating the urine in a normal manner the kidney, in order to rid the system of the daily quota of solids, must excrete a larger amount of dilute urine. As a result of this enforced polyuria the total solids eliminated reach the normal; at the same time abnormal constituents such as sugar or albumin do not appear.¹

The condition must not be confounded with chronic interstitial nephritis nor with arteriosclerotic hypertension. Cardiac hypertrophy, arteriosclerosis, and high blood pressure are absent from the clinical picture of true diabetes insipidus.

Whether a given case belongs to the group of primary polyurias can usually be determined by the sodium chlorid test. When a normal individual on a standard diet containing a definite quantity of sodium chlorid receives an addition of from 10 to 15 grams of NaCl to the daily ration the

¹In rare instances a diabetes insipidus is met with in cases of organic nervous diseases and of traumatic injuries to the skull. While these, as a rule, are types of primary polyurias, perhaps through some disturbance of a center in the medulla, few have been properly studied by the modern methods.

sodium chlorid concentration in the urine increases, while the urine quantity varies little or not at all. In a patient with diabetes insipidus, on the other hand, with a similar experiment, the sodium chlorid concentration of the urine is only slightly affected, but in order to get rid of the excess of salt the quantity of urine excreted is greatly augmented.

It should be remembered, however, in this connection that the concentration of the urine cannot be accurately determined by the estimation of the NaCl; the best method is the determination of the freezing point (Δ).

As these facts are important from the standpoint of treatment I reproduce two tables from a valuable article by Erich Meyer (4):

TABLE I

Behavior of an individual with healthy kidneys on the addition of a single quantity of NaCl to a standard diet.

Quantity of Urine	Spec. Grav.	Δ	NaCl %	NaCl Grams	N %	N Grams
1375	1011	0.78	0.198	2.72	0.803	11.04
1200 (10 gm. NaCl)	1011	0.91	0.444	5.33	0.890	10.70
1700	1012	0.88	0.374	6.36	0.704	11.97
1450	1010	0.75	0.316	4.48	0.570	8.28

TABLE II

Elimination in a case of diabetes insipidus in which, in addition to a diet containing about 9 grams NaCl, 10 grams NaCl dissolved in 15 c. c. water were given through a stomach tube.

	Urine Quantity	Spec. Grav.	Δ	NaCl %	NaCl Grams	N Grams	λ
Preliminary day	7650 c. c.	1004.800	0.23	0.117	8.95	11.78	0.003346
10g NaCl	10600 "	1004.202	0.20	0.176	18.76	11.13	0.004535
Succeeding day	7850	1003.078	0.20	0.105	8.24	11.69	0.002550

Δ —Freezing point of urine.

λ —Electric conductivity.

Treatment.—In the cases of polyuria associated with functional nervous disease a restriction of the water intake may at times be achieved by psychotherapy. As sleep is much disturbed by thirst and the necessity for passing water, benefit may be derived from the administration of bromids and mild hypnotics. The use of chewing gum, slippery elm, etc., may, by allaying the dryness of the mouth, lessen the craving for water.

In the primary cases the treatment is chiefly dietetic. The NaCl test shows us the way. Since the addition of salt increases the polyuria a salt-poor diet is indicated. The quantity of urine does not, however, depend solely on the amount of salt to be excreted—but rather upon the total number of nitrogenous and nonnitrogenous molecules of waste to be eliminated. Hence a diet containing a minimal quantity of urinary waste material is best calculated to reduce the polyuria. Such a diet would be made up of green vegetables, fruit, puddings, pastry, unsalted bread, unsalted butter, and meat without salt. As carbohydrates and fats are well borne free use may be made of them.

Most of the animal foods are poor in salt, and as the proteids do not affect the polyuria to the same extent as salt they are allowable in moderation. A mixed diet containing only 5 or 6 grams of NaCl may be kept up indefinitely without injuring the health of the patient. On such a diet from 3 to 5 liters of urine are excreted in the average case. Instead of salt, mustard, pepper, and other condiments, forbidden in nephritis, may be used. Care should be exercised that as little fluid as possible is taken during the late afternoon and evening, as that makes for less disturbed nights. (More urine is excreted at night than in the daytime.) The more concentrated foods should be incorporated in the meals of the first half of the day. The following table giving the NaCl content of the principal foods may prove useful in preparing diet lists:

SODIUM CHLORID CONTENT OF FOODS

(After Leva, 3)

100 Grams	Grams NaCl
Various kinds of meat.....	0.09 - 0.17
Fresh-water fish.....	0.06 - 0.12
Salt-water fish.....	0.16 - 0.41
Poultry of various kinds.....	0.14 - 0.17
Oysters.....	0.52 - 1.14
Caviar.....	3.00 - 6.18
Smoked and salted meats and fish.....	1.85 - 20.59
Bacon.....	1.0
Ham.....	1.85 - 7.50
Fish in oil.....	1.79 - 5.49
Sausage.....	2.20 - 8.10
Canned soups.....	8.10 - 15.48
Meat extracts.....	1.40 - 14.60
Commercial sauces.....	9.37 - 22.46
Eggs.....	0.13 - 0.21
Egg—white.....	0.31
Egg—yolk.....	0.039
Milk.....	0.15 - 0.16
Cream.....	0.012
Unsalted butter.....	0.02 - 0.21
Salted butter.....	1.0 - 3.0

SODIUM CHLORID CONTENT OF FOODS.—*Continued*

100 Grams	Grams NaCl
Oleomargarine.....	2.19
Cheese of various kinds.....	1.59 - 10.57
Bread.....	0.5 - 0.6
Cereals.....	0.014- 0.046
Flour, various types.....	0.002- 0.35
Oatmeal.....	0.26 - 0.29
Potatoes.....	0.016- 0.078
Legumes.....	0.058- 0.09
Salad.....	0.17
Cauliflower.....	0.15
Spinach.....	0.21
Celery.....	0.49
Canned vegetables.....	0.67 - 1.27
Sauerkraut; pickles.....	0.73 - 1.45
Fruits, various kinds.....	0.004- 0.07
Almonds.....	0.09
Walnuts.....	0.19
Mustard (table).....	2.66
Tea, coffee.....	0.05 - 0.15
Ale.....	0.10
Ordinary drinking water.....	0.002- 0.23
Soups.....	0.3 - 1.0

Drugs have little value in the treatment of diabetes insipidus. Where a syphilitic taint exists mercury, the iodids, or salvarsan may be tried, but they seldom do any good. Strychnin is worthy of a trial—it has proved helpful in several reported cases. The same may be said of theocin, which may be administered in doses of 0.2 to 0.3 grams (3 to 5 grains). Powdered opium (0.06-0.20 gram, 1 to 3 grains), or the extract of opium (0.03 to 0.06 gram, $\frac{1}{2}$ to 1 grain) three or four times a day, sometimes gives temporary relief by lessening thirst; it possesses no curative properties. Arsacetin in doses of 5 to 8 drops of a 10 per cent. solution three times a day has also been recommended. Von Jaksch (2) has used globularin, a glucosid obtained from *Globularia alypum* and *Globularia vulgaris*—0.3 gram (5 grains) given to a patient with diabetes insipidus caused a fall in the quantity of urine from 15 to 10 liters.

Both the preceding drugs require far more study before final judgment as to their efficacy is possible.

Ergot and valerian have been used; but any effect they may have is purely transitory.

The following case (Hugo Bach, 1) affords a therapeutic suggestion that might be tried when the disease is of traumatic origin: A man in 1889, when fourteen years old, had a mastoid operation and an abscess on the right side of the neck. After the operation the patient developed diabetes insipidus, drinking from ten to twenty-five liters of water per day and passing corresponding amounts of urine. The ultraviolet light

from a quartz lamp was applied to the scar and to the back, the duration of treatment being from twelve to twenty minutes. After the first treatment the uncontrollable thirst from which the patient had suffered for twenty-three years was lessened and it disappeared entirely in the course of treatment.

On purely empiric grounds some of the organic extracts have been used. In one case, which came to me by hearsay, pituitary extract seemed to exercise a beneficial effect. An apparent *propter hoc* may, in such circumstances, be only a *post hoc*.

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CHAPTER VI

OBESITY

EDWIN A. LOCKE

INTRODUCTION

Obesity is a condition characterized by the accumulation of more than the physiological amount of body fat. The term is an indefinite one, and it is not always easy to determine precisely the point at which the degree of corpulence becomes abnormal. It should be regarded rather as a symptom of disordered metabolism than as a clinical or pathological entity, unless causing definite functional trouble of the organs or the nervous system. Obesity requires treatment only when such symptoms are present.

Under conditions of health, adipose tissue is found in practically all animal tissues subcutaneously as well as within the cavities of the body. Fat is also stored in the muscles and liver. The distribution, however, is not necessarily proportionate, and varies greatly in different individuals. Fat tissue exists normally in the ratio of approximately fifty grams per kilogram of body weight, i. e., about four kilograms for a person weighing eighty kilograms.

Bishoff (1) gives the composition of the human body as follows:

Water	59	per cent.
Albumin	9	" "
Collagenous material	6	" "
Fat	21	" "
Salts	5	" "

Fat, therefore, comprises roughly one-twentieth of the body weight in adult males. The ratio is somewhat greater in females. Its percentage may, however, vary widely from the above, without the condition being considered actual obesity. In some cases an accumulation of even four to six kilograms, unless accompanied by functional disturbances, may be regarded as within normal limits.

OBESITY

The following tables give a general idea of the average weights of males and females of different heights and according to age periods:

TABLE OF HEIGHT AND WEIGHT AT VARYING AGES*

MALES

Ages ..	15-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69
Height	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight
5-0....	120	125	128	131	133	134	134	134	131	...
5-1....	122	126	129	131	134	136	136	136	134	..
5-2....	124	128	131	133	136	138	138	138	137	.
5-3....	127	131	134	136	139	141	141	141	140	140
5-4....	131	135	138	140	143	144	145	145	144	143
5-5....	134	138	141	143	146	147	149	149	148	147
5-6....	138	142	145	147	150	151	153	153	153	151
5-7....	142	147	150	152	155	156	158	158	158	156
5-8....	146	151	154	157	160	161	163	163	163	162
5-9....	150	155	159	162	165	166	167	168	168	168
5-10...	154	159	164	167	170	171	172	173	174	174
5-11...	159	164	169	173	175	177	177	178	180	180
6-0....	165	170	175	179	180	183	182	183	185	185
6-1....	170	177	181	185	186	189	188	189	189	189
6-2....	176	184	188	192	194	196	194	194	192	192
6-3....	181	190	195	200	203	204	201	198	196	195

FEMALES

4-11...	112	115	117	119	122	125	128	128	126	...
5-0....	114	117	119	122	125	128	130	131	129	...
5-1....	116	118	121	124	128	131	133	134	132	...
5-2....	118	120	123	127	132	134	137	137	136	...
5-3....	121	124	127	131	135	138	141	141	140	...
5-4....	124	127	130	134	138	142	145	145	144	...
5-5....	127	131	135	139	143	147	149	149	148	...
5-6....	130	135	139	142	146	151	153	153	152	...
5-7....	134	139	143	147	150	154	157	156	155	...
5-8....	138	143	147	151	155	158	161	161	160	...
5-9....	142	147	151	155	159	163	166	166	165	...
5-10...	146	151	155	159	163	167	170	170	169	...

*These tables are published through the courtesy of Dr. Frederick L. Hoffman, statistician of the Prudential Insurance Company of America. The figures for males are based on 74,162 and for females on 58,855 applicants for life insurance.

PHYSIOLOGY

In order effectively and intelligently to treat the obese, it is absolutely essential to start with a clear understanding of the physiology of the condition, since the treatment is largely based on the principles of nutrition.

The food requirements for the healthy individual leading an ordinary active life are, roughly, 40 calories per diem per kilogram of body weight, or for one weighing 80 kilograms (176 pounds) a total of 3,200 calories. There is no exact proportion of the three nutritive constituents furnishing this fuel value which may be taken as a standard, but studies of various American diets show that the average is approximately as follows:

100	grams	protein.....	410	calories
150	"	fat	1,395	"
350	"	carbohydrates	1,435	"
			<hr/>	
			3,240	"

It is evident that these food requirements vary within wide limits depending on many factors. For example, the necessary calories are markedly influenced by the amount of energy expended, the above requirements of 3,200 calories being reduced nearly one-half when the individual is completely at rest. Many other factors, such as the weight, area of skin surface, type of life with respect to the expenditure of heat and energy, age, sex, climate, seasons, etc., exert a very marked influence on the fuel needs. Furthermore, the natural daily variations in the diet and appetite must also result in a considerable variation in its total caloric value. Even such slight departure from the normal as cannot be appreciated by the individual may readily cause an increase or diminution in the food value of several hundred calories. For example, 100 calories is represented by one small lamb chop, one average size boiled potato, three large prunes, one large orange, one ordinary pat of butter, one slice of bread, or one small glass of milk.

It is extremely doubtful if, under ordinary condition of life in health and following the dictates of appetite, we ever eat too little food during a given day. Nature's method seems to be to a certain degree to use the human body as a storehouse for fuel. When the diet contains more food than is necessary to answer the demands for heat, energy, and internal work, a certain portion of the excess is preserved in the body in the form of fat. During a period of insufficient nutrition this store of fat can be drawn on and utilized by oxidation to furnish energy either

in the form of heat or muscular work. In the great majority of individuals this accumulation of adipose tissue does not exceed the normal limits of approximately one-twentieth of the body weight, but in others the excess of food leads to the deposit of an excessive amount.

Foods through oxidation in the body serve two functions, namely, as tissue builders and as sources of energy (muscular work, internal work, and heat). The various food constituents meet these needs in varying degrees. The formation and repair of body tissues are derived solely from the protein, water, and mineral matter. Fats and carbohydrates under no consideration serve this function. It is seen, therefore, that the proteids represent the most important form of food and are absolutely essential in considerable quantity to maintain life. Indeed, on a pure protein diet, with mineral matter and water, life may be sustained and even relatively perfect health be maintained for a long period. The chief dangers of an exclusive protein diet are that, first, unless eaten in enormous amounts, so large a part is required to supply energy that an inadequate amount remains for tissue repair; and, second, that the large increase may lead to serious disorders of digestion.

That body heat and energy under normal conditions are largely derived from the carbohydrates and fats is generally accepted, but when present in excess of the quantity needed for tissue repair, the protein is also metabolized to the same end. Indeed, many physiologists believe that the body cells may derive their energy from all with equal facility provided the supply is adequate. Rubner (14) has shown that the various food constituents can be compared with reference to their value as sources of heat in accordance with their caloric value. The comparison is made on the basis of the quantity of each necessary when oxidized in the body to raise one kilogram of water from 0° to 100°. The resulting weights he calls their "isodynamic value." He gives the following summary:

	Calories yielded by 100 grams	Isodynamic values
Fat	942.3	100
Cane sugar	400.1	235
Bread	280.2	336
Meat	96.3	978
Milk	67.3	1,400

In general, since 1 gram of protein or carbohydrate oxidized in the body yields 4.1 calories and 1 gram of fat 9.3 calories, it follows that 1 gram of fat is equivalent to approximately 2.3 grams of either carbohydrate or protein. Usually the energy required is provided entirely or in large part by combustion of the fats and carbohydrates, thus leav-

ing the protein to answer the demands for tissue building. It is evident, then, that, while neither the fats nor carbohydrates can replace protein as regards this function, both may, by reason of the greater readiness with which they are oxidized to yield energy, spare the proteids for this purpose.

The adipose tissue of the body is chiefly formed directly from the fats and indirectly from the carbohydrates ingested, but in larger proportion from the latter. The carbohydrates are absorbed into the blood as dextrose, which is then converted into glycogen, and as such stored in the liver and muscles. In similar manner, protein if in excess may also be a source of fat, as in the case of the carbohydrates, probably going through the intermediate step of glycogen formation. Under ordinary conditions of health there is good evidence to the effect that but little, if any, fat is formed from this food stuff.

A word should be said regarding alcohol. When taken in small amounts, that is, a few ounces daily, it is oxidized in the body exactly as in the case of the carbohydrates and fats, to furnish energy, and hence similarly may spare the proteids. Unlike the other food constituents, alcohol cannot form body fat. It is important to remember that, while alcohol in small quantities is a food, in larger amounts it acts as a drug, which action may outweigh its effects as a nutrient, since it may interfere with the digestion and assimilation of other foods.

To summarize, then, the functions of the various foods are as follows: energy in the form of muscular work or heat may be provided by the oxidation of protein, carbohydrates, fats, or alcohol, but from the first named only when the supply of the others is insufficient. Fat tissue is formed directly from fat ingested; carbohydrates and likewise protein under some circumstances are also transformed into body fat. Body tissue except fat is derived only from protein. Mineral matter participates in tissue formation, especially bone, and aids digestion.

Certain facts regarding metabolism during a period of prolonged fasting are of the greatest importance, because of the direct application to principles laid down later for the regulation of the diet during a reduction cure. Since during starvation no carbohydrates are ingested, and the reserve of glycogen is so small as to be of no consequence, it follows that the sources of energy during fasting must be from the body protein and fat. Lusk (9) states that, in the case of a normally nourished individual, the fasting metabolism is practically constant, 13 per cent. of the total energy being furnished by the protein and the remaining 87 per cent. from the fats. From the results of a large number of experimental studies Lusk (9) makes the deduction that "the quantity of protein metabolism in starvation depends upon the amount of fat in the body." When the body fat is abundant a much smaller proportion of protein is used than otherwise. In the absence of fat the energy may be entirely

derived from the burning of protein. In any case, the destruction of protein constantly increases as the amount of available fat diminishes. As emphasized by the same writer, it also follows that the loss in body weight is much greater when the energy is derived chiefly from the protein rather than from the fat.

In the reduction of weight it is obviously important to bring about a loss of the panniculus adiposus without a loss of body protein; in other words, to preserve nitrogen equilibrium while the carbon equilibrium is destroyed. Experiments have shown that this is readily accomplished (Lusk, 9).

Some consideration of heat loss is necessary as bearing especially on the methods employed in stimulating the metabolism in the treatment of the obese. In general, metabolism is increased by external cold and decreased by external heat, in accordance with the need for the maintenance of a constant body temperature. The temperature of the cells of the organism is then maintained through the regulation of metabolism, which Rubner has shown to be proportional to the area of the surface of the body. The body loses heat by (1) conduction and radiation; (2) evaporation of water from the lungs and skin; (3) warming of the ingested food, and (4) warming of the inspired air (Lusk). By far the most important paths through which heat is lost are the evaporation of water and conduction and radiation. It is clear that the degree of loss must depend on many internal as well as external factors, too numerous to discuss in this chapter.

At normal or low temperature, and in moderately dry air, the excretion of water through the skin by the obese does not differ from the normal (Rubner). Of special interest is the fact that, in hot climates with high humidity, the obese can dissipate the heat of metabolism by evaporation of perspiration less easily than thin people, and therefore work less advantageously. The amount of water thrown off by the skin is much greater than that of normal individuals, and Von Noorden states that as much as three to four liters may be excreted in a few hours. Thus it will be seen that fat people are limited in the degree to which they can regulate the heat of metabolism through radiation, with the result that under certain conditions there may be increased internal heat and great discomfort.

Von Noorden (20) says: "The ingestion of a quantity of food greater than that required by the body leads to an accumulation of fat, and to obesity, should the disproportion be continued over a considerable period." He groups the causes of obesity under three heads, as follows: (1) An increased food supply with normal energy expenditures; (2) a normal food supply with diminished energy expenditures, and (3) a combination of the two. While seemingly a very satisfactory grouping, in many cases of obesity it is not possible to determine from which com-

bination the condition arises. That there is in all cases of this condition an excess of food over the quantity needed to answer the body's needs is evident for the reason that, as shown above, food is deposited as adipose tissue only under such conditions. In other words, the disproportion between the intake of food and that metabolized is always present. Such an excess need not be great, or even regular, for, if only slight but long continued, an abnormal amount of fat tissue may be formed. Simple calculation will show that an average excess of 100 calories per day will mean an accumulation of many pounds of fat in the course of a few years. Fat tissue is normally present in the body, and why, with the abundant diet of the well-to-do, a condition of obesity does not always develop is difficult to explain. Clearly other factors than the above mentioned must necessarily be present.

Since the loss of body heat is directly proportional to the body surface, and this area is relatively less in fat people, it should follow that a relatively smaller amount of food per kilo of weight will suffice to maintain the obese than the normal individual. Hence, an amount of food sufficient to answer the needs of the well may, in the case of the former class, be slightly in excess of the body needs, and sufficient to cause a further accumulation of fat. As is well known also in this class of individuals, there is a general tendency to inactivity with a consequent decrease in the caloric needs. The sedentary indoor life with lessened muscular activity in these cases, so often observed, results in a greater or less depression of general vitality. That this may lead to a lessening of the power of the body cells to oxidize food can hardly be doubted. Although the metabolism in the obese is usually said to be normal, von Bergmann (19) recently proved that, in some cases at least, metabolism is diminished. This abnormal condition von Noorden has termed "the slowing of metabolism," by which he means to indicate that the cells use less fuel than normal in providing energy in the form of external work. In such a condition may be found the interpretation of the so-called "constitutional tendency" present in so large a percentage of cases. Unquestionably in many instances the predisposition to obesity can be analyzed to mean a lack of the proper amount of exercise with an increased quantity of food. This idea is strengthened by the fact that the increase in weight very often comes at the time of life when these factors are especially potent. The predisposition must often be regarded as strictly hereditary. Oertel believes that at least 50 per cent. of all cases fall in this class. In a large series of cases tabulated from among private patients I found that nearly 70 per cent. give a definite family history of excessive weight sufficient in degree to suggest the probability of an inherited tendency to the condition on the part of the patient.

The increase in nitrogenous metabolism observed in Graves' disease

first suggested the use of thyroid extract in the treatment of obesity. Precisely how the gland exerts its influence on the general metabolism is not known, but many observations have shown that in such conditions as myxedema, which are due to lessened activity of the thyroid, the metabolism is lowered, while in such diseases as exophthalmic goiter, in which there is present an increased activity of the gland, the metabolism is strikingly stimulated. Effects exactly similar to the latter have been repeatedly observed to follow the ingestion of thyroid extract in both man and animals. The principal effect is in the increased oxidation of protein.

Much has been written regarding the relation of body weight to the secretions of the sexual organs. It has long been held that castration in either sex tends to induce a condition of increased adipose tissue. This, however, seems very doubtful in the light of recent experiments. The frequently observed increase in weight at puberty, after the menopause, and following lactation likewise does not prove any definite relation to sexual functions. The accompanying hyperalimentation with the tendency to indulgence in fat-forming foods and diminished bodily activity appear to be more rational causes.

PROPHYLAXIS

Prophylaxis, though of the utmost importance, is often extremely difficult. While relatively simple to carry out, it is frequently quite impossible to convince people, especially those in good health, of the symptoms which will later follow, and of the consequent necessity for the adoption of measures directed to the limiting of the adipose development. Until the degree of obesity becomes extreme, or until late in its course severe symptoms appear, the corpulent are seldom willing to submit to the necessary régime of treatment. Prevention of obesity is of greater importance than the treatment of the condition. With the appearance of the early signs of increase in fat tissue, the individual should be warned of the probably further increase and the symptoms and complications which will follow. The causes can usually be found in the mode of life with a lack of muscular activity, or in a diet which over-supplies the caloric needs of the system. The principles to be followed are discussed under treatment. In every case the measures advised should be chosen with especial reference to the indications of the individual case.

Prophylaxis is especially indicated in the offspring of the very obese, and should be undertaken even in the early years. In the case of children, however, the greatest care should be exercised in the restriction of the diet, lest the general nutrition become impaired. By a careful limiting of the fat-forming foods and regulation of exercise in the open

air, undue accumulation of fat can, as a rule, be successfully prevented. Residence in the country and in summer at the seaside are desirable as favoring an outdoor life.

With the approach of middle life in both sexes most frequently is noted the tendency to corpulency, and it is at this period that prophylaxis is most important. All excesses in eating and drinking should be prohibited, and the individual encouraged to live an active life as much as possible in the open air. Out-of-door sports, such as tennis, golf, riding, rowing, and especially walking are of great advantage. Sea bathing affords one of the most ideal forms of exercise.

TREATMENT

CHOICE OF CASES

One of the most important considerations is the decision as to the suitability of a given case for a reduction cure. Not all fat people should attempt to lose weight. Nature never meant that all should conform to a common standard in this regard. It is very questionable if those who are only moderately fat and who show no symptoms should be treated, provided they live a rational life as regards diet and exercise. A moderate degree of corpulence is consistent with perfect health.

The very young, even if they show an extreme degree of overweight, should practically never be placed on a rigid régime. It is almost impossible under such circumstances during the early years of life to surely provide against a retardation of development. One should be content with instituting a routine of diet and exercises to protect against further increase in weight. The aged are also unfavorable cases. Any considerable loss in weight almost certainly leaves them much older in appearance, and often actually hastens decay. Another unfavorable class are those who have been fat since early years. If reduced at all, it should be done very slowly and with extreme care.

The discussion as to the advisability of reducing weight should always be influenced by the condition of the kidneys, heart, circulation, and general vitality. Although organic disease is usually a contraindication to treatment, it should not be forgotten that it is sometimes such a condition as this which makes a reduction cure imperative. The presence of diabetes or tuberculosis is practically always an absolute contraindication.

The most favorable cases are those under middle life, who are in good general health, and in whom the condition of obesity is of relatively short standing. Men, as a rule, yield to treatment more readily than women.

GENERAL CONSIDERATIONS

If carried out according to scientific principles and with careful attention to the minutest details, the cure of obesity is exceedingly simple in the great majority of cases. Indeed, the response to rational treatment is often so prompt that the danger most necessary to be guarded against is a too rapid reduction. The physician very commonly must resist the demands of his patient that the loss in weight should be more rapid. Frequently the desire is expressed to complete the course of treatment in a few weeks, notwithstanding the fact that the gain in weight is the result of many years of gradual increase. The purpose of the treatment is to reduce the body weight through the loss of fat tissue, and not the oxidation of body protein with loss of strength, which inevitably results if the rate of decrease is excessive. The reduction should always be accompanied by an increase of strength and general vitality. Any symptom of weakness is always to be interpreted as a danger signal and a certain sign that the régime is faulty in some respect. The unfortunate results of bad treatment are responsible for the idea so prevalent that reduction cures are always attended with grave dangers. In the minds of the laity almost every possible bodily ill can be attributed to bad effects of such treatment. If the treatment be intelligent and temperate, one need never fear the slightest unfavorable results. Furthermore, the decrease in weight leads to important changes in the general metabolism, and especially the work of the internal organs. This readjustment must obviously be brought about gradually. The rate of loss depends on the total weight of fat to be destroyed. If only five to ten pounds, it makes little difference how rapidly it is removed. In the case where the amount is greater, the rate of loss should not be more than six to eight pounds per month, and then for a period of only two or three months. With the very obese the amount should not exceed forty or fifty pounds in a single year, and even that amount only in robust individuals who improve in health month by month with the reduction.

My own plan is to continue the treatment for short periods of usually about two months with intervals of a few weeks to two months between, during which the diet and exercises are so regulated as to maintain the weight so far as possible at a constant level. With each succeeding period of active treatment the ratio is materially lessened. After a loss of thirty to forty pounds a longer interval of several months or an entire season is arranged.

We should remember that fat is a normal constituent of the body, and that our object should never be to entirely rid the body of it, but only the excess. Neither is it possible to fit all people finally to the same mold. Experience indicates the degree to which a given individual may carry

the treatment. A certain fairly definite point is always reached where further loss of weight necessitates a very great and unreasonable restricting of the diet and increase in the measures intended to augment the energy requirements. This point can be regarded as the normal weight for the given individual.

The obese themselves, not the obesity, are to be treated. In other words, it is not a simple condition of overweight in most cases, but a very complicated group of symptoms due to a generally disordered nutrition. Our aim should be to "restore the nutritive equilibrium." Unless this can be accomplished, the results will not be permanent or the vitality improved. In treating the obese we are dealing largely with unnatural habits which must be changed. The patient has formed the habit of eating the wrong things or in inordinate amounts; he is taking too little exercise or of the wrong kind. It is necessary, therefore, literally to reorganize the entire program of life.

Further, the variety of the causes underlying the obesity indicates that in the routine laid down every attention must be given to the individual. No set formula can possibly be applied to all cases alike. In the following pages, therefore, a rather general program will be outlined, to be modified and adapted to the individual cases as is necessary.

The question often arises if the patient can obtain better results at home or at a health resort where the entire attention is devoted to the treatment. The answer is, I believe, that in the majority of cases far better results can be obtained by the former method. Cures made at a sanatorium are carried on under conditions which are essentially unnatural, and little is accomplished in effecting any radical change in the mode of life. Ordinarily the patient who carries out this régime in a health resort gives himself up entirely to strenuous out-of-door exercise (walking, mountain climbing, etc.), a restriction of diet amounting to starvation, and severe purging, and in the brief period of a few weeks brings about a very material loss of weight. Returning to his home he finds it impossible to continue the particular sanatorium régime and soon lapses into his former mode of life, with the result that the lost weight quickly returns. The cure has been too rapid and carried on under conditions and in an environment quite apart from his daily life. Von Noorden says:

"In regard to these courses of rapid reduction treatment, it is much more important, in order to obtain permanent and lasting results, to induce the patient to follow certain sensible rules at home and to persevere in the mode of life that is arranged to suit the peculiarities of each case and the external circumstances in which the patient happens to be living."

Since, as explained above, obesity is the result of an excess of food over that which is utilized for the body needs, the treatment must consist in the regulation of the diet and of those factors which determine the body's needs for energy. Of the two, the former is of far greater importance, yet the latter is essential. Either if used alone is ineffectual.

DIETETIC TREATMENT

Before discussing the dietetic regulations, it will be well to consider briefly the essentials of several of the more important and best known systems of diet for obesity. All are based on essentially the same principle, namely, to diminish the caloric value of the diet so far as is consistent with the maintenance of nutrition and strength. The method by which this is accomplished through the reduction in the quantity of the different food constituents varies considerably. The quantity of fluids allowed also differs materially, but in nearly all the diet may be considered a "dry diet." Systematic exercise is prescribed with varying emphasis.

The Harvey-Banting Cure.—In 1863 a pamphlet appeared in London entitled: "A Letter on Corpulence Addressed to the Public," in which the author gives an account of his success in reducing his own weight through a system of dieting laid down by his physician, Dr. Harvey. For a period of twenty years Banting had tried in vain many methods, some of them violent, of reducing his excessive weight, but, having failed, sought the advice of Harvey, who suggested a diet very poor in fats and carbohydrates. Meat was allowed freely, and also water and claret. The diet is as follows:

Breakfast, 9 A. M.—Meat (mutton, beef, kidneys, broiled fish, bacon, or cold meats), 4 to 5 ounces. Tea without sugar or cream, 1 cup, 9 ounces. Toast (or 1 small biscuit), 1 ounce.

Dinner, 2 P. M.—Lean meat or fish, 5-6 ounces. Vegetables (any kind except potatoes, carrots, and parsnips). Dry toast, 1 ounce. Fruit (cooked, but unsugared). Claret, sherry, or Madeira, 2-3 glasses.

Tea, 6 P. M.—Fruit, 2-3 ounces. Rusk (or toast), 1 or 2. Tea without sugar or cream, 1 cup.

Supper, 9 P. M.—Lean meat or fish, 3-4 ounces. Claret or sherry, 1-2 glasses.

During the course of about ten months Banting lost 35 pounds, and was strikingly improved in general health. On the basis of his own experience, Banting speaks of the especial importance of the absolute restriction of all butter, bread, milk, beer, fat meats, and sugar.

The above diet represents roughly about 172 grams proteids, 250 grams fruit and vegetables, 90 grams bread, and 1,020 c. c. fluids, or a total of probably about 1,200 calories. Its chief characteristics are, therefore, (1) abundance of protein, (2) very marked restriction of fats and carbohydrates, (3) water in normal amounts, and moderate quantities of light wines.

Although one of the most simple and popular of the many methods of treating corpulence, Banting's régime is really of very little value.

The most serious objection lies in the undue predominance of the proteid food, which in such quantities is difficult of digestion and assimilation, and is apt to lead to gastric and intestinal disorders, and, furthermore, puts undue demands on the kidneys. Likewise, the restriction of the fats and carbohydrates is entirely unreasonable and so great as to lead to a disturbance of nitrogenous equilibrium, it seems certain. The excess of nitrogenous food may be oxidized to supply energy, but less easily than carbohydrates and fats. The excess thus available for heat and muscular work is inadequate. The diet is also monotonous.

The Epstein Diet.—W. Epstein (3) likewise tried a special form of diet on himself, with good results, which has since been extensively employed, particularly in Germany. The unsatisfactory results obtained by the use of Banting's diet led Epstein to formulate a plan which, in many respects, is the exact opposite. Epstein claims that his "cure" can be applied without serious interference with the ordinary manner of life of the average individual or undue self-denial. He further aims by his diet to produce lasting cure, instead of temporary results. The principles on which this form of treatment is based, as defined by its author, are as follows: It has been proven that the ingestion of moderate amounts of fat does not lead to an increase of body fat, and that a reduction of weight may be accomplished by a diet rich in fat, provided the carbohydrates be limited and the mode of life made to conform to normal standards. Fat is a necessary constituent of normal diet, and cannot be excluded entirely without serious detriment to the organism. A diet rich in fat, according to Epstein, satisfies the hunger more completely and for a longer period than one composed chiefly of protein and carbohydrates. He denies that this is due either to resulting indigestion or depression of the appetite, as suggested by critics. The true explanation is found in the fact that fat remains in the stomach for a considerable period and, therefore, requires a proportionately large amount of work on the part of this organ.

In brief, this system of diet consists in (1) a considerable limitation in the carbohydrates, and (2) in a slight relative increase in the fat. Only such vegetables are proscribed as contain a high percentage of starch, the so-called green vegetables rich in water being allowed in abundance. A special form of bread containing from 20-30 per cent. of albumin is recommended. Fruits, raw and stewed, without sugar, are allowed in moderation, likewise a small quantity of wine poor in sugar and alcohol. Beer is especially prohibited. Albumin is given in somewhat restricted amounts. Fluids are not restricted, as in many other systems, but, according to Epstein, the large amount of fat definitely satiates the appetite for fluid and thus less is taken. Three meals a day are given:

6-7 A. M.—Tea without sugar or milk, 250 c. c. Dry toast, 50 grams. Butter, 20-30 grams.

2 P. M.—Thin soup. Fat meat with fat gravy, 130-180 grams. Green vegetables. Salad. Fresh fruit (apple or berries). Light Rhine wine, 2-3 glasses. Soon after this meal, plain, strong tea, 250 c. c.

7.30-8 P. M.—Meat with fat (egg or fish), 75-80 grams. White bread, 30 grams. Plenty of butter. Cheese (occasionally). Fresh fruit.

The value of the Epstein diet is usually given as protein, 102 grams; carbohydrates, 47 grams; and fat, 85 grams, or the equivalent of about 1,300-1,400 calories.

That the results attributed by Epstein to the increase in fat mentioned above actually follow is doubted by many. It is the opinion of von Noorden that the carbohydrates in considerable quantities are quite as effective as the fats in satiating hunger. Many patients cannot with comfort take a diet so rich in fat. The program laid down by Epstein is, however, one which can be very readily adapted to different individuals, and is especially applicable in those who are fond of fat foods.

The Oertel Cure.—The "Oertel cure" has enjoyed a wide popularity in Germany. This system of diet, to quote Oertel, "is based on the pathological changes in the heart and amount of circulatory changes caused by them. To avoid burden to the heart we must diminish the quantity of both solids and fluids." He believes that large amounts of fluid seriously interfere with the involution of the body fat and, therefore, great stress is laid on the withdrawal of fluids. This he advises should be brought about by restricting the fluids taken and by depletion of the body tissues by sweating. In those with normal heart action the normal physiological measure of 1,500 c. c. per diem of fluid is allowed; in those with weak heart action, from 750 to 1,200 c. c. With very large individuals, or when the body temperature is high, the quantity is sometimes raised to 1,800-2,000 c. c. The diet is chosen with regard to the type of case, whether "plethoric," "anemic," or "hydremic." Albumin is greatly increased, while the carbohydrates and fats are correspondingly cut down, the latter proportionately more than the former.

	Albumin	Fat	Carbo- hydrates	Calories
Minimum	156	25	75	1,180
Maximum	170	45	120	1,608

The maximum diet is prescribed for those doing hard muscular work. A general daily menu is given:

Breakfast.—Wheat bread, 35 grams. Coffee, 120 grams, with milk, 30 grams, and sugar, 5 grams. 2 soft boiled eggs (or meat, 100 grams), 90 grams. Butter, 12 grams.

Second Breakfast.—Milk, Rhine wine, or bouillon (or water), 100 grams. Cold meat, 50 grams. Rye bread, 20 grams.

Dinner.—Broiled beef, 150-200 grams. Salad or vegetables, 50 grams. Cereal (or bread, 25 grams), 100 grams. Fruit, 100 grams. Rhine wine, 250 grams.

Tea.—Coffee with milk, 30 grams, and sugar, 5 grams.

Supper.—Caviare (or smoked salmon, 18 grams, or 2 soft boiled eggs), 12 grams. Game, 150 grams. Cheese, 15 grams. Rye bread (or fruit, 100 grams), 20 grams.

Careful consideration is given to exercises and baths.

The above method is, on the whole, one of the most satisfactory, and because of its flexibility can be adapted to the various types of cases. In the opinion of many authorities, the total protein is too high. Grave danger sometimes accompanies the restriction of fluids, and the majority of cases ordinarily seen do not furnish the definite indication in form of heart weakness as given by Oertel.

The Schweninger System.—The Schweninger system (16) combines restriction of diet with exercise (gymnastics and massage). The diet differs but little from Oertel's. He gives somewhat more carbohydrates, less fat, and the fluids are restricted only with meals or within one to two hours following:

7 A. M.—Mutton chop. Bread without butter.

8 A. M.—Cup tea with little sugar.

10.30 A. M.—Small slice bread and sausage.

12 M.—Soup, meat, potatoes, green vegetables, cheese, 2 glasses white wine, fruit.

4 P. M.—Cup tea with little sugar.

7 P. M.—Little bread with cheese.

9 P. M.—Cold meat, salad, 2 glasses wine.

Robin's Diet.—Robin (13) contends that the ingestion of large amounts of fluid increases the oxidizing powers. The diet is ordered with reference to two classes into which he divides all cases of obesity according to the cause, namely, first, those resulting from increased assimilation, and, second, those resulting from decreased oxidation of food. In the first he reduces the fats and especially the fluids; in the second he gives large quantities of liquids in order to increase metabolism.

Robin's diet gives two good meals a day, and is characterized by being made up essentially of nitrogenous substances and green vegetables. He also gives careful directions regarding exercise and the general hygiene.

8 A. M.—1 egg. Bread, 10 grams. Meat, 20 grams. Cup weak tea without sugar.

10 A. M.—2 eggs. Rusk, 5 grams. Wine or water (or tea without sugar), 150 grams.

12 M.—Lean meat, 250 grams. Vegetables, 100-150 grams. Raw fruit, 100-150 grams. Red wine, 1 to 2 glasses.

7 P. M.—Meat, 100 grams. 1 egg. Vegetables, 150 grams. Cup weak tea without sugar.

Bouchard's Method.—Bouchard (2) claims less weakening effects in the use of his method than are seen with many. His aim is the improvement of general nutrition as well as loss in weight. The diet consists exclusively of 1,250 grams of milk and five eggs (1,200 calories) per diem, divided into five meals at four-hour intervals for a period of twenty days. Following this the patient is given a more varied diet, but without increasing the amount of albuminates. The proper balance of the various food constituents is later maintained by a careful choice of green vegetables and fruit. The fats are given only in such small quantities as are necessary to take care of the bile and pancreatic juice. Much use is made of physical therapy.

Hirschfeld's Diet.—Hirschfeld's (5) diet closely resembles Epstein's, but furnishes only about 45 grams instead of 85 grams of fat. It restricts all the nutrients, especial emphasis being laid on the necessity for satisfying the appetite without increasing unduly the amount of nutrient.

Breakfast.—Cup black coffee and roll.

Forenoon.—2 eggs.

Dinner.—Bouillon with 30 grams rice (weighed uncooked). Lean meat, 250 grams, with little fat.

Afternoon.—Black coffee.

Supper.—Cream cheese, 50 grams. Bread, 100 grams. Butter, 10 grams.

v. Noorden's System.—v. Noorden's (21) system combines diet regulation with exercise and hydrotherapy. Particular attention in these regulations is given to the different grades of obesity and to the complications. For practical purposes v. Noorden arranges three groups with regard to the severity of dietary restrictions necessary. In the *first grade* the total calories are cut down about one-fifth, namely, from about 2,500 to 2,000 heat units, and the treatment continued for a long time. The monthly loss in weight at first should not be greater than three to four pounds, and later not more than two to three pounds. This moderate reduction in the food is sufficient only for those leading a life requiring a relatively great amount of muscular activity in the open air. In the *second grade* the diet is reduced approximately two-fifths, that is, from about 2,500 to 1,400-1,500 calories. Here also the rapidity of reduction in weight and the total loss will depend on the amount of energy used in exercises or work. As a rule, from four to six and later two to four pounds per month may be lost. The treatment may be continued practically without interruption for many months, or even years. It is especially adapted to those leading an indoor life, but who can continue

treatment for a long time; to strong individuals who can be sent to the mountains and without medical supervision may combine the dieting with moderate travel; to those with complicating diseases, particularly of the heart, and, finally, to those cases of high grade obesity with whom the ordinary diet is to alternate with periods of restriction. The reduction in the *third grade* is three-fifths, or from 2,500 to 1,400-1,000 calories, and corresponds roughly with the diets proposed by Banting, Oertel, Epstein, and others. It represents the most extreme reduction of the diet and should be employed with great caution. The loss in weight is usually from six to twelve pounds per month.

v. Noorden gives three chief meals with small lunches of low caloric value during the intervals:

8 A. M.—Cold lean meat, 80 grams. Bread, 25 grams. Cup tea or coffee (little milk, but no sugar).

10 A. M.—1 egg.

12 M.—Cup strong soup without fat.

1 P. M.—Small plate clear soup. Lean meat or fish, 150 grams. Potatoes, 100 grams. Green vegetables. Fresh fruit (or compote with sugar), 100 grams.

3 P. M.—Cup black coffee.

4 P. M.—Fresh fruit, 200 grams.

6 P. M.—Glass skimmed milk (or tea).

8 P. M.—Cold lean meat, 125 grams. Pickles, etc. Graham bread, 30 grams. Small serving cooked fruit (without sugar).

The value of this diet is given as, roughly: 156 grams protein, 29 grams fat, and 112 grams carbohydrates, representing 1,366 calories. A glass of wine is permitted twice each day, but not with the principal meals. v. Noorden regulates the number of heat units in the diet according to the weight of the individual and the needs for energy, as indicated by the mode of life. No routine restriction of the fluids is made except as especially indicated by heart and other complications.

Karrell's Diet.—Karrell (8) recommends an absolute milk diet in the treatment of obesity complicated with circulatory disorders, especially in the case of edema. The total amount per day in some instances among Karrell's cases was as low as 800 c. c. Exercise is kept at a minimum. Moritz (11) reports the results of very careful metabolism experiments made with especial reference to this diet. He finds it especially valuable in cases with heart complications and nephritis. The total quantity given by this author is from 1,200 c. c. to 2,500 c. c. per diem, divided into small amounts, five to eight times daily. The precise amount is accurately regulated according to the body weight, as a rule from 16 to 17 calories per kilogram of body weight being given. He recommends more exercise than Karrell. It is claimed for the "milk cure" that it acts as a diuretic, gives very prompt results, that it is most simple of regula-

tion, and even in small amounts completely satisfies the appetite and thirst. As carried out by Karrell and Moritz, however, it is a more rigorous restriction than some patients can tolerate without more or less harmful effects. Many cannot take milk exclusively for a long period, and with the majority it soon becomes a very tiresome diet. Perhaps the most serious objection is the fact that sooner or later the patient must return to a mixed diet, and meantime nothing has been accomplished in the way of acquiring a knowledge or habit of regulation of the normal diet in order to control the body weight.

Comparison of Diets.—A comparison of the proportion of nutrients and fuel values of some of the more important of the above diets is given in the following table:

COMPARISON OF VARIOUS DIETS

	Protein, Grams	Fat, Grams	Carbo- hydrates, Grams	Total Calories
Normal diet.....	100	150	350	3,240
Epstein.	100	85	50	1,400
Harvey-Banting.....	172	8	81	1,100
Hirschfeld:				
Maximum.....	134	46	122	1,500
Minimum.....	95	43	106	1,220
Oertel:				
Maximum.....	170	45	120	1,608
Minimum.....	156	25	75	1,180
Robin.....	140	44	82	1,290
Von Noorden.....	155	28	112	1,366

General Principles to Be Observed.—The reduction of weight in the obese, if done scientifically, is attended with no dangers whatsoever, but unreasonable or careless restrictions in the diet almost inevitably lead to unfavorable symptoms, or at times even to serious detriment to the general health. Reduction should, therefore, never be undertaken except under the close supervision of a competent physician. As has been emphasized above, the loss of superfluous adipose tissue is a matter which depends on much more complex regimen than the mere cutting down of the food ingested. All measures adopted should be employed to the end that the individual's mode of life be so reorganized that fat tissue is not only reduced, but the weight permanently maintained at the point reached. Of all the methods used dietetic regulation is with very few exceptions the most important, yet others are essential. Success in treatment is at-

tained only when the underlying causes of the obesity are sought out and treated.

The patient must be under constant surveillance, and to this end should be seen by the physician at least once each week, certainly during the first part of the treatment. Explicit directions regarding the kinds and exact amounts of food to be taken are necessary, and equally precise records of the food taken should be regularly furnished by the patient. By no other means is this possible except by a daily report of every article of food eaten, together with the approximate amount. In a few instances it may be necessary to actually weigh the food eaten, but under ordinary circumstances a sufficiently exact idea of the daily diet may be obtained if the quantity is given in terms of simple measure, i. e., "one tablespoonful," "average slice," etc.

I have often found it helpful to have patients weigh the food for the first one or two weeks in order that they may be able to indicate accurately the quantity eaten. The value of the daily diet kept in this way can be figured with sufficient accuracy for all practical purposes.

An adequate safeguard against too great a reduction in the intake of food and at the same time more reliable than the total fuel value of the food alone is to be found in the observation of the weekly loss in weight and the influence on the appetite, strength, and general appearance. After the first few weeks there should be little or no inconvenience from hunger, and both the strength and general appearance should improve with the loss in weight.

It is desirable that each case should have scales at hand in order that the weight may be taken daily. The variations from day to day and at different times of day are such that the weights, in order to be strictly comparable, should be taken on rising and without clothes. A chart of the weight by weeks is of great assistance to the physician in regulating the treatment.

It should be constantly kept in mind that eating is to some degree a matter of habit, and most people beyond early adult life eat to excess. A gradual cutting down of the amount of food ingested very promptly leads to a change in the habits, and the individual is completely satisfied with considerably less food.

The arrangement of meals is of some importance. The appetite is unquestionably satisfied more completely and the unpleasant sensations of hunger largely avoided by frequent meals, as suggested by v. Noorden and others. Such an arrangement, however, is, as a rule, inconvenient, and, in my experience, entirely unnecessary as a routine. If during the long interval between the first two meals of the day there arise troublesome sensations of hunger or faintness, I advise a small luncheon at eleven-thirty, consisting of a little fruit, a cup of bouillon, a glass of but-

termilk or skimmed milk. In the afternoon a cup of tea and a very small amount of solid food usually suffice to allay these symptoms. The taking of fluid alone in some form without nourishment will frequently be sufficient.

It is well to take advantage of those factors which tend to depress the appetite to a moderate degree and to shun those which stimulate it. Prolonged chewing of the food reduces the appetite by causing satisfaction with a smaller volume of food, and should always be advised. Similarly, more food is generally eaten when the variety is great. For this reason relatively few courses are to be recommended, i. e., seldom more than three to five. On the other hand, too monotonous a diet may depress the appetite unduly and should, therefore, be guarded against. Condiments and stimulants in general are prohibited, as they quicken the desire for food.

Physiological research as well as experience has proved that adipose tissue may be formed from any of the food constituents when taken in excess, as stated above, though from the proteids only to a relatively small extent. When the diet contains more protein than is utilized by the body for tissue repair, the superfluous portion is much more apt to be metabolized to form heat and energy. It follows, then, that under ordinary conditions the chief sources of body fat are the carbohydrates and fats. The question as to which serves as the more important source of fat has not been satisfactorily answered, but it seems probable that the carbohydrates are relatively more important in this direction than the fats.

Considering these facts, the fundamental principle may be laid down, in the dietetic treatment of the obese, that the first consideration is that the total number of calories per diem should be materially lessened rather than any particular restriction of special kinds of food be made. This principle is borne out in actual experience by the success attending the use of the different methods previously described, which differ greatly in the restrictions which they make with regard to the various food constituents. The total food value of the diet must be reduced considerably below that which is required by the system, and the difference between this value and that required is made up by oxidation of the organism's own fat. The degree to which this reduction should be made varies with each individual, and it is impossible to lay down any definite rule.

In the majority of instances I have found it necessary to reduce the caloric value at least one-half and sometimes two-thirds. For the average individual of normal health and reasonable activity, a diet consisting of 100 grams protein, 60 grams fat, and 120 grams carbohydrates, or with a total caloric value of 1,448, may be considered a fair average. This represents, in the case of an individual weighing 200 pounds, approximately 16 calories per kilogram of body weight in contrast to the normal average of 40 calories per kilo. Some individuals will lose

satisfactorily on a diet furnishing 1,800 or even 2,000 calories per diem, but, as a rule, in order to effect a loss of from one to two pounds per week, it is necessary to restrict the diet to about 1,400 calories. In a few instances I have employed a diet as low as from 900 to 1,000 calories. The reason for this marked reduction in the food is found in the relatively enormous fuel value of the body fat. For example, the oxidation of two pounds of body fat in a given week furnishes considerably more than 8,000 calories, or approximately 1,200 heat units per day.

While, as stated above, the cutting down of the caloric value of the food is the first essential, it is also very important that the diet be so selected as to avoid excessive hunger. The aim should be the satisfaction and not the satiation of the appetite, and this end is dependent to a very large degree on the volume of the food. In other words, one should choose a bulky or so-called "fodder diet." In order to accomplish this purpose it becomes necessary to restrict greatly those foods which for a given bulk have a comparatively high value. From the fact that 100 grams of butter, for example, furnish 795 calories and 100 grams of string beans, cooked, 21 calories, the force of the above principle is evident. It will be seen that the exclusion of even a moderate amount of butter will materially lower the fuel value of the diet, while the inclusion of an ordinary helping of string beans will furnish considerable bulk without the addition of many calories. In general the types of food yielding a relatively large number of calories are almost exclusively the carbohydrates and fats; consequently these are the types of food which should be particularly limited. The degree to which each should participate in the restriction will depend largely on the taste of the individual. For those who are especially fond of carbohydrates I am accustomed to make the fats share more largely in the reduction, and vice versa.

In my experience the following menu fulfills the above requirements, very satisfactorily:

BREAKFAST:

- Cup black coffee (with milk, but no cream or sugar).
- Raw fruit (1 orange, apple, pear, or $\frac{1}{2}$ grapefruit).
- Eggs (one or two, boiled or poached).
- Toast (one or two small slices, i. e., 10-20 grams, usually without butter).

11:30 A. M.:

- Cup bouillon (250 c. c. skimmed milk or buttermilk or fruit).

LUNCHEON:

- Clear soup, 120 c. c.
- Moderately lean meat or fish, 100 grams (or eggs).
- Two varieties green vegetables, 50-100 grams each.
- Raw fruits.

5 P. M.:

Tea without cream or sugar.
(Small slice toast, 10 grams.)

DINNER:

Raw oysters.
Moderately lean meat or fish, 100-150 grams.
Two varieties green vegetables, 50-100 grams each.
Salad (fruit or vegetable) with small quantity of French dressing.
Raw or unsweetened cooked fruit.
Demi-tasse black coffee.

The above menu represents, according to the choice, a maximum and minimum value as follows:

	Protein.	Fat.	Carbohydrates.	Calories.
Minimum	60	50	70	1,000
Maximum	100	70	165	1,738

FOODS ALLOWED

Meats and Fish.—All lean meats and fish, except as noted below, but without rich dressing or sauce.

Thin soups in moderation.

Eggs in any form, except scrambled, fried, and omelette.

Fruits, all fresh varieties (except bananas), and berries (without cream and sugar); cooked, if with saccharin.

Vegetables.—String beans, water cress, lettuce, radish, cucumber, asparagus, green peas, Brussels sprouts, cabbage, cauliflower, okra, onions, celery, watermelon, tomato, artichoke, spinach, white potato in moderation, mushrooms, squash, beets, turnips, carrots, parsnips, oyster plant, vegetable marrow (cooked with but little butter and no cream).

Miscellaneous.—Tea, coffee, skimmed milk, lemonade (with saccharin), ginger ale. Desserts made of gelatin, or Irish moss, if with but little sugar; use saccharin or saxin in place of sugar.

FOODS TO BE AVOIDED OR GREATLY RESTRICTED

Starches.—Bread, crackers, cereals, macaroni, vermicelli, spaghetti, sago, tapioca, cornstarch, sweet potatoes, shelled beans, dried peas or beans, corn, and nuts.

Sweets.—Sugar, candy, dried fruits, syrups, fruit preserves, honey, marmalade, and sugar sauces.

Meats.—Pork, bacon, goose, sausage, croquettes.

Fish.—Shad, fresh salmon, eels, sardines, mackerel, bluefish. Fried fish.

Fats.—Butter, cream, olive oil, bacon, lard; fat meats and fishes.

Desserts.—Ices, rich puddings, cake, and gingerbread.

Miscellaneous.—Chocolate, alcoholic beverages, except claret and Rhine wine, thick soups, milk, cheese, pickles, and condiments.

Reference to the above lists will give a general idea of the choice of food, and to the following table more exact facts regarding the weights and relative values of those from which to select the diet:

PREPARED FOODS—EDIBLE PORTION*

FOOD STUFFS	Quantity	Wgt. Grams	Protein		Fats		Carbo- hydrates		Total Calories	Calories per 100 Grams
			Grams	Calo- ries	Grams	Calo- ries	Grams	Calo- ries		
1. MEATS										
<i>Beef</i>										
Corned beef, canned...	1 slice	50	13.15	53.9	9.35	87.0	...	...	141	282
Roast.....	1 slice	100	22.30	91.4	28.60	266.0	...	...	357	357
Roast, very lean.....	1 slice	100	23.33	95.7	1.66	15.4	...	...	111	111
Steak, round, fat re- moved.	1 slice	100	27.60	113.2	7.70	71.6	...	...	185	185
Steak, tenderloin.....	1 slice	100	23.50	96.4	20.40	189.7	...	...	286	286
Sweetbread.....	1 slice	80	32.00	131.2	.45	4.2	...	...	169	169
Tongue, canned.....	1 slice	25	4.88	20.0	5.80	53.9	...	...	74	295
<i>Chicken</i>										
Capon.....	1 slice	100	27.00	110.7	11.50	107.0	...	...	218	218
Fricassee.....	1 slice	100	17.60	72.2	11.50	107.0	2.40	9.8	189	189
Roast.....	1 slice	100	32.10	131.6	4.40	40.9	2.10	8.6	181	181
<i>Lamb</i>										
Chop with bone.....	1 chop	100	21.70	89.0	29.90	278.1	...	...	367	367
Roast.....	1 slice	75	14.78	60.6	9.53	88.6	...	...	150	150
<i>Mutton</i>										
Boiled, lean.....	1 slice	75	23.18	95.0	3.38	31.4	...	...	126	168
Chop, lean.	1 chop	100	22.60	92.7	4.50	41.9	...	...	135	135
Roast leg.....	1 slice	75	18.75	76.9	16.95	157.6	...	...	234	313
<i>Pork</i>										
Chop.....	1 chop	70	17.92	73.5	4.20	39.1	...	...	113	161
Ham, smoked, boiled as purchased.....	1 slice	33	7.29	29.9	6.80	63.2	...	...	93	291
<i>Turkey</i>										
Roast.....	1 slice	100	27.80	114.0	18.40	171.1	...	...	285	285
<i>Veal</i>										
Cutlet.....	1 cutlet	80	22.82	93.6	1.14	10.6	...	...	104	133
Roast.....	1 slice	75	21.33	87.5	1.00	9.3	...	...	97	132

*From "Food Values," 1911, Table II, by E. A. Locke, D. Appleton & Co.

Unless otherwise stated the values are for food as prepared for the table.

Abbreviations: a. = average, d. = diameter, h. = heaping, m. = medium, dsp. = dessertspoon, tbsp. = tablespoon, tsp. = teaspoon.

PREPARED FOODS—EDIBLE PORTION (Continued)

FOOD STUFFS	Quantity	Wgt. Grams	Protein		Fats		Carbo- hydrates		Total Calories	Calories per 100 Grams
			Grams	Calo- ries	Grams	Calo- ries	Grams	Calo- ries		
2. FISH										
Bluefish.....	.....	100	25.90	106.2	4.50	41.9	...	...	148	148
Cod.....	.....	100	21.68	88.9	.27	2.5	1.58	6.5	98	98
Haddock.....	.....	100	21.98	90.1	.36	3.3	3.63	14.9	108	108
Halibut.....	.....	100	20.35	83.4	4.04	37.6	...	...	121	121
Mackerel.....	.....	70	11.73	48.1	4.84	45.0	2.62	10.7	104	148
Smelts.....	1 fish	14	2.23	9.1	.26	2.4	.06	.2	12	85
Spanish mackerel, broiled.....	.....	100	21.80	89.4	5.90	54.9	...	...	144	144
Sturgeon, Russian cav- iarc.....	1 h. tsp.	10	3.00	12.3	1.97	18.3	.76	3.1	34	337
Trout, brook.....	.....	50	10.57	43.3	1.17	10.9	.62	2.5	57	114
Shellfish										
Clams, long.....	6 clams	150	12.90	52.9	1.5	14.0	3.00	12.3	79	53
Clams, round.....	6 clams	100	6.50	26.7	.4	3.7	4.20	17.2	47	47
Crabs, hard shelled, as purchased.....	1 crab	245	19.36	79.4	2.21	20.6	1.47	6.0	106	91
Lobster.....	.....	105	17.22	70.6	1.89	17.6	.42	1.7	90	86
Oysters.....	6 oysters	85	5.27	21.6	1.02	9.5	3.15	12.9	44	52
Oyster stew.....	4 oz.	124	6.07	24.9	11.06	102.9	10.53	43.2	171	138
3. SOUPS										
Beef, home-made.....	4 oz.	120	5.28	21.6	.48	4.5	1.32	5.4	32	26
Bouillon, canned.....	4 oz.	120	2.64	10.8	.12	1.1	.24	1.0	13	11
Consommé, canned...	4 oz.	120	3.00	12.3	...	...	.48	2.0	14	12
Julienne, canned.....	4 oz.	120	3.24	13.3	...	...	.60	2.5	16	13
Tomato, canned.....	4 oz.	120	2.16	8.9	1.32	12.3	6.72	27.6	49	41
Vegetable, canned....	4 oz.	120	3.48	14.3	...	...	.60	2.5	17	14
4. DAIRY PRODUCTS AND EGGS										
Butter.....	1 ball	15	.15	.6	12.75	118.6	...	...	119	795
Cream										
"Average".....	1 tbsp.	20	.74	3.0	5.14	47.8	.71	2.9	54	269
Cheese										
Camembert.....	1 h. tsp.	20	4.20	17.2	4.34	40.4	...	...	58	290
Dutch.....	2 scoops	20	7.42	30.4	3.54	32.9	...	...	63	316
Fromage de Brie.....	1 cu. in.	20	3.18	13.0	4.20	39.1	.28	1.2	53	267
Limburger.....	1 cu. in.	20	4.60	18.9	5.88	54.7	.08	.3	74	369
Neuchatel.....	1 cu. in.	20	3.74	15.3	5.48	51.0	.30	1.2	68	337
Roquefort.....	1 cu. in.	20	4.52	18.5	5.90	54.9	.36	1.5	75	375
Koumiss.....	wineglass	130	3.64	14.9	2.73	25.4	7.02	28.7	69	53

PREPARED FOODS—EDIBLE PORTION (Continued)

FOOD STUFFS	Quantity	Wgt. Grams	Protein		Fats		Carbo- hydrates		Total Calories	Calories per 100 Grams
			Grams	Calo- ries	Grams	Calo- ries	Grams	Calo- ries		
DAIRY PROD. (Con.)										
Milk										
Buttermilk.....	1 glass	218	6.54	26.8	1.09	10.1	10.46	42.9	80	36
Skimmed milk.....	1 glass	222	7.55	31.0	.67	6.2	11.32	46.4	84	37
Whole milk.....	1 glass	220	7.26	29.8	8.80	81.8	11.00	45.1	157	72
Whey.....	1 glass	203	2.03	8.3	.61	5.7	10.15	41.6	56	28
Eggs										
Hens', boiled	1 egg	50	6.60	27.1	6.00	55.8	...	...	83	169
Hens', uncooked.....	1 egg	50	6.70	27.5	5.25	48.8	...	...	76	159
Hens', whites, boiled..	1 egg	32	4.16	17.1	.06	.6	...	...	18	55
Hens', yolks, boiled...	1 egg	18	2.89	11.8	5.99	55.7	...	...	68	376
5. VEGETABLES										
Artichokes, French....	1 artichoke	360	6.48	26.6	.29	2.7	16.56	67.9	97	27
Asparagus, canned....	.....	125	1.88	7.7	.13	1.2	3.50	14.4	23	19
Beans:										
Butter.....	4 h. tbsp.	80	3.78	15.5	.24	2.2	11.60	47.6	65	81
String.....	2 h. tbsp.	60	.48	2.0	.66	6.1	1.14	4.7	13	21
Beets.....	2 h. tbsp.	70	1.61	6.6	.07	.7	5.18	21.2	29	41
Beet greens.....	2 h. tbsp.	100	2.20	9.0	3.40	31.6	3.20	13.1	54	54
Cabbage.....	3 h. tbsp.	100	.60	2.5	.10	.9	.40	1.6	5	5
Carrots.....	3 h. tbsp.	100	.53	2.2	.17	1.6	3.39	13.9	18	18
Cauliflower.....	2 h. tbsp.	120	1.08	4.4	.12	1.1	.48	2.0	8	7
Celery, uncooked.....	3 small stalks	55	.50	2.1	.05	.5	1.43	5.9	8	19
Cucumber, uncooked..	8 thin slices	50	.40	1.6	.10	.9	1.55	6.4	9	18
Dandelion greens.....	2 h. tbsp.	100	2.39	9.8	1.01	9.4	10.67	43.8	63	63
Mushrooms, uncooked	2 large	45	1.58	6.5	.18	1.7	3.06	12.5	21	46
Onions.....	1 onion	100	1.20	4.9	1.80	16.7	4.90	20.1	42	42
Parsnips.....	4 slices	100	.22	.9	.29	2.7	1.46	6.0	10	10
Potatoes, boiled.....	1 medium	150	3.75	15.4	.15	1.4	31.35	128.5	145	97
Squash.....	2 h. tbsp.	100	1.36	5.6	.82	7.6	13.60	55.8	69	69
Spinach.....	2 h. tbsp.	100	2.10	8.6	4.10	38.1	2.60	10.7	57	57
Tomatoes, canned....	2 h. tbsp.	70	.84	3.4	.14	1.3	2.80	1.4	16	23
Tomatoes, uncooked..	m. size	200	2.40	9.8	.40	3.7	8.00	32.8	46	23
Turnips.....	2 h. tbsp.	140	.45	1.8	.08	.7	.91	3.7	6	4
6. FRUITS										
Fresh, as purchased										
Apple.....	a. size	150	.45	1.8	.45	4.2	16.20	66.4	72	49
Blackberries.....	3 h. tbsp.	100	1.30	5.3	1.00	9.3	10.90	44.7	59	59
Cantaloupe.....	½ melon	465	1.40	5.7	...	...	21.39	87.7	93	20
Cherries.....	About ¼lb.	100	.90	3.7	.80	7.4	15.90	65.2	76	76
Cranberries.....	1 cup	100	.40	1.6	.60	5.6	9.90	40.6	47	47

PREPARED FOODS—EDIBLE PORTION (Continued)

Food Stuffs	Quantity	Wgt. Grams	Protein		Fats		Carbo- hydrates		Total Calories	Calories per 100 Grams
			Grams	Calo- ries	Grams	Calo- ries	Grams	Calo- ries		
FRUITS, FRESH (Con.)										
Currants.....	4 h. tbsp.	100	1.50	6.2	...	...	12.80	52.5	59	59
Grapefruit ..	1½ large	300	2.37	9.7	.60	5.6	30.27	124.1	139	46
Grapes.....	1 bunch	150	1.50	6.2	1.80	16.7	21.60	88.6	112	74
Gooseberries.....	4 h. tbsp.	90	.90	3.7	...	...	11.79	48.3	52	56
Huckleberries...	4 h. tbsp.	100	.60	2.5	.60	5.6	16.60	68.1	76	76
Lemon.....	a. size	130	.91	3.7	.65	6.0	7.67	31.4	41	32
Orange.....	a. size	250	1.50	6.2	.25	2.3	21.25	87.1	96	37
Peach.....	a. size	128	.64	2.6	.13	1.2	9.86	40.4	44	34
Pear..	a. size	156	.78	3.2	.62	5.8	19.81	81.2	90	57
Pineapple,edible port'n	2 slices	100	.40	1.6	.30	2.8	9.70	39.8	44	44
Plum.....	a. size	35	.32	1.3	...	...	6.69	27.4	29	81
Raspberries.....	3 h. tbsp.	82	.82	3.4	...	...	10.33	42.3	46	56
Strawberries.....	4 h. tbsp.	100	1.00	4.1	.60	5.6	7.40	30.3	40	40
Watermelon.....	Large Slice	300	.60	2.5	.30	2.8	8.10	33.2	39	13
7. BREAD, CRACKERS, ETC.										
A. Bread:										
Toasted.....	4x2x¼ in.	10	1.15	4.7	.16	1.5	6.12	25.1	31	313
White, home-made....	3x4x½ in.	37	3.37	13.8	.59	5.5	19.72	80.9	100	270
B. Crackers:										
Butter.....	d. 2 in.	4	.38	1.6	.40	3.7	2.86	11.7	17	427
Graham.....	3 in. sq.	8	.80	3.3	.75	7.0	5.90	24.2	34	429
Pretzels.....	.....	6	.58	2.4	.23	2.1	4.37	17.9	22	375
Saltines.....	2 in. sq.	3	.32	1.3	.38	3.5	2.06	8.4	13	492
Soda:										
Educators.....	2 in. sq.	3	.97	4.0	...	...	1.39	5.7	10	333
Uneda biscuits....	3 in. sq.	6	.59	2.4	.55	5.1	4.38	17.7	25	424
8. MISCELLANEOUS										
French dressing.....	1 dsp.	11	...	...	8.00	74.4	...	...	74	673
9. NON-ALCOHOLIC BEVERAGES										
Coffee or tea with ¼ c. milk.....	1 cup	246	2.06	8.4	2.50	23.3	3.12	12.8	45	18
Lemonades:										
Egg lemonade with 1 egg, 2 tbsp. lemon juice.....	1 l'ge glass	314	6.70	27.5	5.25	48.8	2.35	9.6	86	27
Lemonade with white of egg, 2 tbsp. lemon juice.....	1 l'ge glass	297	4.10	16.8	.08	.7	2.35	9.6	27	9
Plain lemonade with 2 tbsp. lemon juice...	1 glass	264	...	...	...	...	2.35	9.6	10	4

Except at breakfast, where it is usually wise to allow a cup of coffee, the limitation of fluids in all forms at meals is advisable. It seems questionable if they have any significant effect on metabolism, but when taken with solid food, fluids certainly tend to increase the quantity eaten. For this reason, and because they stimulate the appetite directly, soups are best excluded from a strict diet. An abundant quantity of fluid should be taken at other times, however, best at least two hours after, or not later than one-half hour before meals. Bedtime and on rising are also favorable times for free drinking of fluids. The frequent observation of the specific gravity and quantity of the urine furnishes a sufficiently reliable guide as to the amount of fluid necessary. As a rule, 1,500-2,000 c. c. of water or its equivalent in any form of liquid during twenty-four hours is sufficient, but this standard varies within wide limits, depending on the size of the individual, the type of life, the presence or absence of certain complicating diseases, season of the year, and many other factors. Rarely, if ever, should the total fluids be reduced lower than 1,000 c. c. per diem. The abundant consumption of liquids is especially indicated in those cases taking a large amount of protein food, in order to aid in the excretion of the products of nitrogenous metabolism.

Alcohol when oxidized in the body yields a relatively large number of calories, and even in small amounts may add sufficient value to the diet to prevent satisfactory loss in weight. Those alcoholic beverages with a high content of alcohol or carbohydrates should under nearly all conditions be strictly forbidden. An exception is found in those patients who have habitually taken such beverages to excess, and in these it is best to permit a moderate quantity. If the weight is decreasing satisfactorily an occasional glass of claret or Rhine wine can be taken at dinner without interfering with the success of the treatment.

Many patients suffer great deprivation from the restriction of the starchy foods, and especially bread. In such cases the substitution of bread made from gluten flour or one of the many proprietary breads poor in starch will often be found helpful.

MECHANICAL THERAPY

Though of less value than the dietetic treatment, the employment of methods to increase the demands for energy with resulting increased oxidation of food is indispensable. This end is reached through many channels, and the choice of the particular method and the degree to which it shall be used depend on many considerations. The production of either heat or muscular work means the oxidation of fat and carbohydrates in the food, and if these sources be inadequate, the body fat as well, and, therefore, acts advantageously in the reduction of weight. A

further and still more important reason for the carrying out of this form of treatment is the beneficial influence which exercise exerts on the general vitality, and especially on the muscular system [notably that of the heart.—Editor]. The oxidation of fat is always most active, and consequently, the loss in weight most rapid, in those whose general condition of health is most nearly normal. It follows, then, that, in the well-developed and vigorous obese, methods of physical treatment serve chiefly to increase the metabolism of fats and carbohydrates, while in the case of the debilitated the first consideration is the development of the body vitality through improvement in the functions of the internal organs. Careful employment of these methods makes it possible to bring about satisfactory results with less rigid restriction of the diet.

Whatever the method used may be, the most careful attention must be given to the general health of the patient, especially to the condition of the circulatory system and kidneys. In case serious disorders of these organs be present, great harm may be done by their injudicious use. The same applies to nearly all other complicating conditions. In some instances it may be wise at first to use only dietetic treatment. The response to physical treatment varies in almost inverse ratio to the age; in those past middle life and in the aged the results are, as a rule, very unsatisfactory and often entirely negative.

v. Noorden has emphasized the fact that physical therapy gives the best result in those individuals in whom the obesity is due to the "retarded metabolism" rather than dietetic errors. As in the case of the dietetic treatment, constant care should be given to the minutest measures, for, if too strenuous or if the weight reduction be too rapid, there is always danger of loss of body albumin as well as of the body fat, with resulting loss of vigor. For short periods only it may at times be advisable to use vigorous methods, but in general the rule may be laid down to begin with mild procedures, and to increase gradually as the condition of the patient and the response to treatment warrant. The observation of the effects on the patient is a far safer guide than any a priori estimation of how much can reasonably be given.

Exercise.—Exercise is the most convenient of the physical measures used, and in the cases without complications the most effective. In the great majority of instances this form alone is sufficient. The influence of exercise in augmenting the metabolism is largely effected through stimulation of circulation, hence the special danger in the presence of circulatory disorders, particularly high grade atheroma or cardiac insufficiency. Since the majority of obese subjects, either as a cause or a result of the condition, take comparatively little bodily exercise, it is almost always necessary to prescribe a definite graduated program. One occasionally sees cases, however, even among the corpulent, of undue physical exertion, most frequently perhaps among those who in the effort to reduce their

weight have resorted to very severe forms of physical exercise. Any form which is so severe as to be in the slightest degree exhausting leads, as a rule, if continued, to a depression of the general vitality. Cases of failure to reduce weight due to too much exercise are not uncommon. Because of this danger, it is my practice to discourage the participation in the most vigorous types of sports where the excitement of sharp competition leads to unconscious excess in muscular exertion. Oertel especially has advocated systematic walking, graded as to time, rate, and degree of incline. While useful in cases of weak heart, such a precise regulation in the average case is entirely unnecessary. Only general supervision of the actual exercise is, in the great majority of instances, all that is required. Preferably it should be in the open air and the particular kind is a matter of indifference. I select that form which is most pleasant and easiest for the particular patient, whether it be walking, riding, climbing, competitive sports, provided they are not too vigorous, swimming, etc. Naturally the great majority take up walking, and, as a rule, can very soon work up to a walk of three-quarters to an hour each morning, and for a shorter period of time in the afternoon. For the average case this is sufficient, but in those with unusual vigor more is sometimes indicated. Deep breathing during the exercise contributes to its beneficial results.

Three factors, then, are to be considered in regulating the form and degree of exercise: (1) the general strength and vitality of the individual, and especially of the heart; (2) complicating conditions, and (3) individual habits and preferences.

Nearly every system of reduction cure gives some place to *calisthenics*, and, undoubtedly, if conscientiously followed out, they are an aid. Few persons, in my experience, have the persistency to carry them out with sufficient regularity to produce results. Where possible, it is wise to insist on a few of the more vigorous movements for a few minutes on rising and at bed time.

Passive mechanical exercise, as with the Zander apparatus, and resistance movements afford a means of some importance, but it is seldom possible to employ them with cases treated in their homes. These have the great advantage that they can be absolutely controlled, and are mainly used in those cases of obesity with heart and other complications in which active exercise is contraindicated. They are especially in vogue in the health resorts.

Massage.—In my hands massage has very frequently proved an important adjunct to the general treatment, though of far less value than active exercise, and, when the latter can be satisfactorily taken, unnecessary. Through its action in stimulating the circulation and restoring the tone of the depleted muscles, it exerts a considerable influence on metabolism. To some degree local accumulation of fat can be effectively treated by massage. In women of very sedentary

habits it is of great assistance. It is necessary that it should be very vigorous and done regularly at practically daily intervals.

HYDROTHERAPY

Rubner (15) found after a cold bath at 15° C. for fifteen minutes a decomposition of only 10.7 grams of fat, which was increased to 19.7 grams with cooling off and after effects, and calculated that a loss of one kilogram would require 100 such baths. Although in general the results of hydrotherapy appear comparatively slight, when taken in conjunction with exercise the benefits cannot be questioned. Strasser (18) considers the various hydrotherapeutic measures of some value, but chiefly important as preparatory to massage. v. Noorden (21) gives five indications for the use of hydrotherapy in the treatment of obesity, as follows: (1) to improve the condition of the skin; (2) to harden against colds and bronchitis; (3) to increase the resistance of the nervous system; (4) to improve circulation, and (5) to accelerate the loss of weight. Through these results hydrotherapeutic measures undoubtedly exert a very marked influence in building up the general vitality and stimulating metabolism. Because of this indirect influence of procedures of this sort, they must be regarded as of some real value in the program for the reduction of the obese. The more special measures can only be given in a specially equipped institution, but such simple measures as cold baths may be carried out at home very satisfactorily.

MEDICINAL TREATMENT

This form of treatment is, on the whole, both unsatisfactory and unnecessary. Careful regulation of the diet and exercise with possibly the addition of massage and hydrotherapy are sufficient to reduce satisfactorily the great majority of cases. The treatment of obesity is essentially better hygiene. Of the many drugs suggested, the majority have no noteworthy action and should be uniformly discarded. Various iodine preparations at one time or another have enjoyed a considerable reputation as fat reducers, but no convincing proof has yet appeared of any especially favorable action, and no indications are present for their use.

A large number of secret internal remedies and external applications have been much advertised and are widely used by the laity. Hutchison (7) gives the analyses of a considerable number of these nostras. This report of his examinations gives no basis for their use. In the treatment of various complications, such as disorders of circulation and digestion, drugs may, of course, find an important place in treatment. Their indications and method of administration need not be discussed here.

Extracts of certain glandular organs have long been known to exert a very marked influence on metabolism. Most important among these are the preparations made from the thyroid, which, probably through stimulation of the nervous system, lead to an enormous stimulation of the metabolic processes. Thyroid extract has been so widely employed in reduction cures as to merit more than passing mention. Yorke-Davies (24), Wendelstadt (23), and Magnus-Levy (10) have shown that the administration of the thyroid gland in the obese leads to an increase of the oxygen consumption and carbon dioxid excretion. Somewhat later work on animals by Voit (22) proved the important fact that the increased metabolism following this method of treatment resulted in an increased oxidation of body protein. v. Noorden (20) believes this to be a sufficient contraindication to its use in reducing corpulency, and further states that the results mentioned above, while the rule, do not in all cases necessarily follow. He also lays stress on the fact that in obesity the thyroid secretion is diminished.

IIoyten (6) studied one hundred cases of obesity, and concludes that the action of thyroid extract in the young is nil, while the maximum results are obtained in adult females between the ages of thirty-five and forty-five. The last-mentioned author, together with many others, speaks warmly of the excellent effects obtained by the use of thyroid preparations. In the majority of cases large doses unquestionably lead to unfavorable or even alarming symptoms, among them glycosuria, or true diabetes mellitus, vertigo, insomnia, digestive disturbances, palpitation, tachycardia, arrhythmia, and, rarely, to Graves' disease. It is also true that the stimulation of metabolism is purely an artificial one, and therefore in no way affects permanently the body weight. If used, it should be given in small doses of one to two grains twice or three times daily, and very cautiously increased.

In a few instances, in middle-aged women especially, I have observed excellent results follow the employment of this method as supplementary to the dietetic-mechanical treatment. As a rule, it is unnecessary, and should not be given, except in those rare cases where a strict regulation of diet and exercise fail to bring about a loss in weight. Good results in women, especially those past the menopause, have been recorded, but the method lacks a scientific basis and is of very doubtful value.

Gerhardt (4), Seuz (17), and others report good results from the use of sodium borate in doses of from .25 to .5 gram (gr. iv to viii) three times daily, in conjunction with a dietetic regimen. Seuz in his series of six cases met with severe gastrointestinal symptoms in several. In general this method does not commend itself.

Many of the health resorts both in this country and Europe are well known for their treatment of obesity. The most frequented are: Marienbad, Wiesbaden, Homburg, Carlsbad, Ems, Tarasp, Kissingen, Vichy,

and Virginia Hot Springs. The content of mineral salts in these waters is somewhat varied both in kind and amount. Nearly all excite increased peristaltic action of the bowels, leading to frequent evacuations. The obvious result of the purging is to prevent assimilation of food and inevitable depression of nutrition if continued. It is clear that such a method should be used with the greatest caution, and for only very short periods, lest general weakness, especially of the circulation, result. Anemia complicating corpulence is an absolute contraindication to the purging treatment. The plethoric type, on the other hand, do well under such measures, if not too vigorously pushed.

For the average case of obesity without serious complications treatment in a health resort is not to be recommended. The loss in weight is brought about under conditions which are largely artificial, and the results are frequently only temporary, since the treatment has not been directed to the end that the habits of life be altered. As a rule, the rate of loss in weight is unreasonably rapid. It cannot be denied that most excellent results are obtained in the health resorts, but it is impossible to separate the effects of the alkaline waters from other methods of diet, exercise, massage, and hydrotherapy, with which they are combined.

It is well in the majority of cases to supplement the dietetic-mechanical treatment by the use of mild cathartic mineral waters in some form. In fact, it often happens that in the beginning of treatment the restriction of certain foods leads to a marked diminution in the bulk of the residue in the intestines and resulting obstipation. This annoying condition can generally be overcome by the regulation of the fruits and green vegetables in the diet, but it is often necessary to give cathartics at least for a time.

TREATMENT AFTER REDUCTION

In the majority of cases the permanency of the results obtained depends almost solely on the faithfulness with which the regimen which brought about the loss in weight is continued. When the point is reached at which no further loss is desired, the total calories in the food may be materially increased without any significant gain in weight resulting, but the additional diet must be chosen with some care. The treatment, if properly carried out, has by the time the reduction of weight has taken place led to a more or less complete change in the mode of life with reference to the diet and exercise. The patient should, without great self-denial, be able to abstain permanently from the articles of food which have a particularly high fuel value. With occasional supervision on the part of the physician the patient soon learns by daily observations of the weight to regulate the choice of the kinds and amount of food to maintain the weight at a chosen level. Several hundred calories must

be added to the daily diet to prevent further reduction, and this will ordinarily suffice to satisfy the appetite, and I have frequently observed an increase of from 800 to 1,000 heat units without any gain in weight. Likewise, a moderate degree of regular exercise must be systematically followed, though considerably less than during active treatment will suffice.

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CHAPTER VII

RACHITIS

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The earliest contributions on the nature of rickets appeared in the middle of the seventeenth century. Rickets undoubtedly existed before this time, though physicians evidently did not recognize the disorder. About the year 1620 attention was called to this condition; it occurred in such large numbers that it was considered epidemic in western England.

The London Faculty of Medicine appointed a commission of three distinguished physicians, Glisson, Bate, and Regemorter, to study the disease. As a result of the labors of this commission, and especially the distinguished contributions of Glisson, a new era was established in the recognition of this disease. The treatise published by Glisson covers 427 pages and describes many illustrative cases. So accurately was this treatise written that its pathological and symptomatological descriptions are useful even to this day.

The term "acute rickets" which was used by the older writers undoubtedly refers to cases of infantile scurvy. Achondroplasia was formerly described as a form of rachitis. We now know that it is a separate and distinct disorder.

Geographical Distribution.—The regions most affected are those which are cool and cold and which are subject to sudden changes; it occurs more particularly in cities than in rural districts, and is more prevalent in the densely populated tenement-house regions than in the better portions of the city. In the far north, as in Greenland, the disease is rare; in the south temperate zone its occurrence is uncommon. It is rare in the sub-tropical regions, and is said not to occur in the tropics. It is reported that negroes in the tropics seem immune to the disease, while in their more northern habitations they are particularly predisposed.

Pathogenesis.—For many years experimental work has been conducted to ascertain the etiological factors in the production of rickets. Feeding experiments upon animals with the various elements of food have been recorded in the literature of thirty years ago. In the most recent times the

experimentation has been restricted more to the effects of calcium metabolism. The questions propounded have been, "Does rickets result from giving too little calcium in the food or is the normal calcium content of the food not absorbed in sufficient amounts, or is it absorbed and are the bones not able to assimilate it in the normal manner?" The results which have been obtained are not altogether uniform. If animals were fed on a calcium-poor food, or an acid food, or a combination of the two a disease condition occurred which resembled rickets very markedly.

Much investigation has been carried on in an attempt to prove that rickets is due to a perversion of the internal secretions. Many workers have been led to study the relation of internal glandular secretion to rickets; thus Stöltzner in an elaborate investigation thought that the disease was due to a disturbed function of the suprarenal glands. Subsequent research in clinic and laboratory has failed to corroborate this view. Similarly, perversions in the function of the thyroid and the thymus have been invoked to explain this disease, but the evidence has been altogether insufficient to explain the etiology. The parathyroid has been more recently subjected to experimental study. Animal investigation points to the fact that this glandular structure has some important function in calcium metabolism, possibly in combining the calcium, thus leading to its retention in the body. When the gland is excised marked phenomena, such as tetany and convulsions, occur with striking regularity, though there is no conclusive proof that the parathyroid or its secretion plays a constant etiologic rôle in the production of rickets.

If we should attempt to prove that rachitis is caused by a primary deficit of calcium, then we might administer to animals food which is low in calcium to observe the effect experimentally. This has been done, and the results have shown that changes occurred which were similar to those in rickets, though when the bones were subjected to more careful chemical and microscopical analysis it was discovered that the disease was not true rickets. This artificially produced disease has been designated as pseudo-rickets, or, more properly, pseudo-rachitic osteoporosis. This condition represents the physiological reaction of an organism with healthy bone to a calcium-poor food. The bone substance is qualitatively normal and quantitatively deficient in amount. Therefore a deficit of calcium in the food cannot be the cause of rickets.

The second point in consideration of the calcium factor leads to the following question: Granting that calcium is present in the food in sufficient quantity, does some failure occur in its absorption or is it too rapidly eliminated before absorption is possible? In some cases it is conceivable that the calcium is ingested in normal quantity but is lost to the body on account of some defect of digestive function, or that it finds its way beyond the digestive tract, is brought to the bony tissues, and for some reason is not utilized by the bone and consequently must be excreted

by the organs of elimination. Metabolism experiments seem to warrant the belief that calcium is not absorbed or utilized by the bone because of its failure to be retained in the body. This may be due to a defect in digestion or to an inability of bone cells to combine in normal manner the calcium salts, as described above. It has been shown by observers that in some instances more calcium was eliminated from the body than was ingested, and these authors think that milk fat has an unfavorable influence on the retention of both calcium and magnesium. They believe that, on account of an excess of fatty acids in the intestine, there is a combination of the fatty acids with the calcium and magnesium salts of the body, which leads to the formation of soaps which are eliminated as such. Birk, who has been carrying on this investigation, believes consequently that rickets is due to a primary disturbance of fat digestion. This hypothesis is not on a firm foundation, though if it could be ultimately proved that rickets depends on some form of indigestion such an explanation would reconcile clinical data with scientific investigation, and would clear up many gaps in the knowledge of the disease.

Rachitis occurs in children who are fed on many different kinds of foods, even breast milk. In nearly every case of rachitis, irrespective of the kind of food, some evidence of indigestion is present for a prolonged time.

The following hypothesis of Stöltzner seems plausible and has been widely accepted as to the etiology of rickets, namely, that the newly formed bone remains uncalcified because it is not in condition to be impregnated with the calcium which is brought to it in the body fluids. When the calcium is rejected by the bone it must be excreted, and it returns to the intestine, where it combines with the fatty acids to form soaps. If this is true it is necessary to believe the excessive formation of soaps is due to calcium seeking to be eliminated instead of being the result of an abnormal fat digestion.

Etiology.—Diseases which occur during the early period of life and which cause prolonged nutritional disturbances are not infrequently associated with rachitic manifestations.

Noteworthy among diseases associated with rickets is syphilis. Congenital syphilis is not, as Parrot thought, an invariable cause of rickets, but it is known that some of the severest cases of rickets may occur in syphilitic children. Children suffering from whooping cough, measles and its complications, prolonged anemia, are likely to become rachitic.

It has already been said that rickets occurs more frequently in the city than in the country. City children who suffer from want of air and sunlight and are improperly housed are more likely to become rachitic than those who live under more favorable circumstances. It is a well-known fact that children who are rachitic and are removed to the country or to the seashore, or to the mountains, frequently show marked improve-

ment. Kellar has shown that children who lived on the shady side of a certain street were more subject to rachitis than those who lived on the sunny side.

Artificially fed children are more likely to become rachitic than those receiving maternal milk, though it is true that breast-fed children may be attacked by the disease. No one kind of food can be held responsible. It is not true, as has been supposed, that food deficient in fat is the cause of this condition, nor is an excess of carbohydrates or an excess of proteid. In the same measure, it may be assumed that overfeeding of fat in itself is not a cause. Any or all foods which lead to protracted disturbance of digestion, or disturbances of the metabolic function, particularly so far as the appropriation of calcium is concerned, are likely to lead to rachitic changes in the bones and the consequent disturbances of nutrition.

Heredity.—Although rickets has affected the fetus, due to the action of intrauterine causes, nevertheless the influence of heredity upon the production of this disease is doubtful. Feer has shown that mothers who had themselves been rachitic were likely to bear rachitic children, even though they had moved to regions where the disease seldom occurred. In the celebrated case described by Elgood, where one woman bore children from three husbands, only those children were rachitic where the father showed distinct evidence of rachitic deformity. Ziegert made observations over a long period of years, and showed that in those families where the mothers had suffered from rickets the children were similarly affected, while in those cases where mothers were free from the disease the children remained free. It is a fact well known, in every American clinic at least, that certain classes of the population are more frequently attacked by rickets than others. For instance, the Italian and the colored children who visit the clinics of the cities are not only more frequently, but they are more severely, rachitic than any other nationality, independent of the method of feeding, whether artificial or natural.

Prophylaxis.—Proper feeding is undoubtedly the most important factor in prophylaxis. There can be no doubt that a well-regulated breast-feeding is the most efficacious plan in the prevention of rickets. It has been maintained, though it has not been proved, that long-continued lactation tends to cause the disease. Over-feeding, even of breast milk, is undesirable and likely to lead to chronic digestive disturbances. It has long been taught that the early supplemental feeding of starches and animal broths is contraindicated. There is, however, strong clinical evidence that if these supplemental foods are judiciously introduced into the feeding at the seventh or eighth month the child is more likely to be anti-rachitic than otherwise. There can be no doubt that rickets is less frequent, less severe in its manifestations if once established, and more readily cured if present if the patient can be kept out of doors to receive an abundant supply of fresh air and sunlight. There is no more efficient

plan of treatment than to advise a visit to the country or the mountains or the seashore. Fresh air and sunlight are sometimes more valuable than medicine in the treatment of this disorder.

On account of the softness of the bony structures during the first stage of this disease, children should not be permitted to occupy the same position in bed for too long a time, nor should they be allowed to lie continuously on their backs with the occiput pressed on the pillow, because a long continuance of the same position in bed causes pressure on the soft bony parts and is likely to lead to deformity and indentation, particularly of the occiput.

It is also a matter of experience that rachitic infants who are held or carried continuously in the same sitting position are likely to suffer from spinal curvatures. The position of the infant should be changed frequently from one arm to another, and the back and head should be well supported. For the same reason, rachitic babies should not be allowed to walk or stand too soon on account of the danger of producing curvature of the lower limbs.

The bathing of infants suffering from rickets is of therapeutic value. Salt baths are beneficial in those children who perspire profusely, and frequently children are sent to saline bath resorts, where they receive benefit from the out-of-door life and, possibly, the baths themselves.

TREATMENT

Dietetic Treatment.—It is difficult at this writing to pronounce the final word on the dietetic treatment, though in a general way it may be said:

(1) The food should be adapted to the ability of the infant to digest without giving rise to intestinal putrefaction or fermentation. (2) Over-feeding should be avoided, and as a rule five meals, at the most six, should be given daily. Animal broths, beef juice, orange juice, and vegetable broths should be given early, in some instances as soon as the sixth month. In severe cases of refractory florid rickets the animal broths, particularly veal broth, may be given in earliest infancy.

The interval between feedings should be at least three hours. In many instances a four-hour interval is still better. It seems plausible that long rests between feedings favor more complete digestion and assimilation.

Experiments have not proved that sterilized milk is capable of producing rickets. There are some foremost clinicians who believe that boiled milk is capable of producing the disease. Even in the latter instances the evidence is insufficient. Nevertheless, one may begin early, say the fourth or fifth month, by fortifying the milk feeding with orange juice, beef juice, and, in some instances, animal and vegetable broths.

Clean, fresh unboiled milk properly diluted is preferred by the majority of physicians. Clinicians are almost unanimous in condemning as rickets producers the long-continued use of condensed milk, dried milk, and some of the proprietary foods which are diluted with water and ready to serve.

Medicinal Treatment. —Chickens, rabbits, and other animals to whom phosphorus in an elementary form was administered showed a sclerosis of the bony tissue. Following this observation Wegner administered phosphorus to children who were suffering from rickets. Kassowitz, after many years of clinical and histological study, has insisted that phosphorus in minute doses is the most valuable drug in the treatment of rickets. Jacobi, who recognizes the virtue of phosphorus, or phosphorated oil, has pointed out that phosphates are of practically no value in the treatment of rickets.

It has been shown that phosphorus combined with cod-liver oil favors the retention of calcium. Whether this indicates that it favors the activities of calcium metabolism is not known. The empirical evidence in favor of the use of phosphorus as phosphorated oil, or its combination with cod-liver oil, more than justifies its employment. The various preparations of calcium, whether in the form of lime water, or phosphates or lactophosphates, are certainly of no value. Cod-liver oil alone is of doubtful value.

Treatment of Florid Rickets, or the Early Cases.—Very frequently the first symptoms occasioned by the disease are great restlessness and sweating. The child tosses its head and rubs its occiput on the pillow until the hair is literally worn off. With these symptoms there may be associated gastrointestinal or bronchial disorders. These symptoms are frequently overlooked, the mother as well as the medical attendant attributing them to dentition, which is supposed to be in progress. Shortly after the development of these symptoms if the head be carefully examined, especially before the sixth month, the condition which is described as *craniotabes* may be observed. *Craniotabes* is that condition which was first described by Elsässer. It is characterized by softness and a parchment-like compressibility of the cranial bones, particularly of certain areas in the occipital region. In extreme cases the bony structures forming the borders of the anterior fontanelles are soft and readily compressible, as are also the bony margins of the sutures. These cases, if promptly recognized and vigorously treated by instituting a régime of diet and hygiene such as has already been outlined, are favorably influenced and the progress of the disease is cut short. If the disease occurs somewhat later, that is, after the sixth month, *craniotabes* is rare. The extensive changes in the structure of the bone, such as bony protuberance or formation of bosses of the cranial bones, are more common after the sixth month. It is in these cases that the phosphorus treatment is especially indi-

cated. The oleum phosphoratum, each minim of which represents 1/100 of a grain, may be given in one-half to one-drop doses three times daily, diluted in cod-liver oil or a small portion of milk.

Phosphorus treatment must be continued for a long time in order to produce results. Frequently, under this treatment, walking is facilitated, the teeth appear earlier, and the anemia becomes less. The treatment, too, has a favorable effect on the spasms of the larynx, the head sweating, and the convulsions.

The treatment by organotherapy, such as the use of the thyroid, the thymus, and the suprarenal gland substances, has been used only to be abandoned, since these remedies have proved themselves absolutely worthless in the treatment of this disease.

The Blood.—A large proportion of rachitic children are anemic. In the milder cases, however, the blood changes are not constant. In the severer cases attended with enlargement of the lymph nodes and spleen there is leukocytosis. In these cases the reds are somewhat diminished. The administration of iron, small doses of arsenic, and the use of beef juice and green vegetables are indicated.

Respiratory and Intestinal Disorders.—Rachitic children are particularly liable to disturbances of the respiratory tract and the intestinal organs. The treatment of these conditions does not differ materially from the usual routine measures adopted for such diseases. Rachitic children show low resistance and offer unfavorable prognosis in many of the acute infections, particularly those attacking the respiratory system.

Glandular Enlargement.—The lymph nodes may enlarge in this disease in the peripheral locations as well as in the bronchial, tracheal, and mesenteric regions. Sometimes the bronchial glands can be discovered by percussion of the intrascapular or episternal regions, where they present an area of dulness. This is particularly true if the enlargement is extensive. We are accustomed to think of the bronchial glands as being enlarged as a result of tuberculous infection. While this is true in most cases, nevertheless bronchial infections, nontuberculous in character, are not infrequently associated with rickets. Where enlargement of the glands occurs syrup of iron iodid, cod-liver oil, syrup of hydriodic acid, or the iodids of potassium or sodium are useful.

Muscular Weakness.—Massage applied intelligently exerts a favorable influence on affected muscles, which are usually relaxed and remain inactive. The massage must be performed by one who has considerable experience, and the over-zealous operator who is accustomed to treat adults must modify her operations and develop a special technique of a gentle character suitable in the treatment of young children.

Deformities.—The rachitic deformities occurring in bones require special consideration aside from the medicinal, dietetic, and hygienic treatment which have already been referred to. A beginning kyphosis or sco-

liosis may be prevented, especially if the muscles of the back are relaxed, by avoiding holding the child continuously in one position. It is better that such patients be changed from one arm to another, as has already been stated, and that the bed be so arranged that the mattress remains smooth without depressions or elevations. In the same way, the child should not be allowed to lie continuously on one side. If the extremities show deformities during the early stages of rickets, while the bones are still soft, light splints may be applied. As a matter of fact, orthopedic treatment is not called for in the early cases. The consensus of opinion among all surgeons at the present is that, as the muscles contract and undergo permanent development, the bony deformities tend to correct themselves spontaneously, even as late as the fourth or fifth year.

Nervous Complications.—At the present writing rickets and the spasmophilic disorders are not considered in the same chapter by most authors. Nevertheless, the spasmophilic group—convulsions, tetany, and laryngismus stridulus—and rickets are so intimately associated that the writer believes that spasmophilia bears the same relation to rickets as effect does to cause.

Convulsions, or infantile eclampsia, occur with great frequency during the early or florid rickets. Probably the most frequent cause of convulsions during the first year of life is rachitis. The eclampsia which is so commonly supposed to be caused by dentition is in most instances due to rickets. The condition is frequently associated with a softness of the skull bones, particularly in the occipital region, the so-called craniotabes. The convulsions themselves are best treated by the use of bromids (2 to 5 grains) and chloral (1 to 3 grains) for their immediate effect, and phosphorated oil combined with the hygienic and dietetic treatment for the underlying rachitic disorder.

Tetany is characterized clinically by contractions of muscle groups which are painful. They may be intermittent or continuous. The condition is recognized by the over-excitability of the peripheral nerves. The Chvostek symptom is elicited by gently tapping the face over the distribution of the facial nerve, particularly over the malar bone. If the sign be positive then a rapid twitching occurs in the region of the muscles supplied by the nerve.

Trousseau's sign consists of making pressure in the bicipital groove above the bend of the elbow. If the sign be positive the fingers contract and approach one another, single flexion occurs at the wrist, and the hand assumes the position which is spoken of as the "obstetrician hand," because of its resemblance to the position which the hand of the obstetrician assumes when performing obstetrical manipulations. The tendon reflexes are increased and the increased electrical excitability of the nerves is shown when one pole of the galvanic current is applied over a nerve trunk; markedly increased contractions occur in response to relatively weak cur-

ents. The treatment for this condition, like the treatment of general convulsions mentioned above, calls for the use of sedatives, phosphorus therapy, and general hygienic treatment.

Laryngismus stridulus, which is so frequently associated with the nervous phenomena of rickets, is a disease symptom which affects the little patient suddenly. He becomes at once pale, respiration seems to cease, condition of apnea results, which lasts for a fraction of a minute, and this is followed by crowing inspiration. During the period of apnea cyanosis may be intense. This condition may occur during the sleeping hours, but occurs more commonly when the child is awake. It may be attended with convulsions; indeed, this condition is associated so frequently with rickets that it may be considered to stand in an etiologic relation to it. It occurs more commonly during that period when cranio-tabes is present, and seems to bear a special relation to the cranio-tabes of rickets. These cases are best treated by following out the general line of treatment already indicated for rickets. The laryngeal spasm itself should be treated by employing various antispasmodics, sodium bromid in large doses, 3 to 5 grains for a child one year or less; chloral by rectum ($\frac{1}{2}$ to 1 grain), and antipyrin internally in doses from $\frac{1}{4}$ to 1 grain; codein in minute doses ($\frac{1}{60}$ to $\frac{1}{30}$ of a grain). In those cases in which general convulsions occur the inhalation of chloroform must sometimes be resorted to. In the severer cases intubation and even tracheotomy have been performed, though these cases are usually fatal.

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INDEX

Abortive treatment of syphilis, 376.

ABRAMS, double current method of colonic flushing suggested by, in intestinal auto-intoxication, 674; on use of purgatives in treatment of intestinal autointoxication, 671.

ABSCCESS, of the liver, as complication of influenza, 190; of the lung, as a complication of pneumonia, 261; pretracheal, as a complication of diphtheria, 279; tuberculous, as a complication of tuberculosis, 509.

"Abscess fixation," in treatment of pneumonia, 246.

Acetanilid, use of, objections to, in influenza, 187; to relieve pain, in acute rheumatism, 300; in Rocky Mountain fever, 565.

ACETONE BODIES, tests for, 732.

Acetphenetid. *See* Phenacetin.

ACHALMIE, report by, of organism found in acute rheumatism, 293.

ACHONDROPLASIA, 812.

ACIDOSIS, DIABETIC. *See* Diabetic acidosis.

ACLAND, tabulation by, of dates for appearance of eruptions and complications following vaccination, 80.

Aconite, use of, in pneumonia with abnormally high blood pressure, 255.

Aconitin, use of, in tetanus, 348.

ACTINOMYCES BOVIS, 359.

ACTINOMYCOSIS, 359; organism causing, 359; treatment of, 360.

Actual cautery. *See* Cautery.

ADENITIS, accompanying glandular fever, 576.

ADENITIS, CERVICAL, as a complication of diphtheria, 277; as a complication of scarlet fever, 131.

ADENOIDS, removal of, a factor in prevention of acute rheumatism, 296.

ADIRONDACK COTTAGE SANATORIUM, plan of admission to, 471.

Adrenalin, use of, hypodermically or by hypodermoclysis, in the asthenic form of measles, 153; in cardiac toxemias of pneumonia, 252; in cardiac weakness of scarlet fever, 127; for control of hemorrhage in tuberculosis, 500; for control of hemorrhage in typhoid fever, 20; in septicopyemia, 291.

Adrenalin, use of, by intravenous injection, in pneumonia with cardiac toxemia, 252.

Adrenalin, use of, as spray, for "colds" accompanying tuberculosis, 508; in the hemorrhagic form of measles, 155; in otitis media complicating scarlet fever, 131.

Adrenalin, use of, for stomach lavage in gastric hemorrhage, 155.

ADRIAN, isolation of influenza bacillus by, 190.

ÆSCULUS HIPPOCASTANUM. *See* Horse-chestnut.

ÆSCULUS PAVIA. *See* Buckeye.

AFEBRILE PNEUMONIA. *See* Pneumonia.

Affusion, cold, use of, in delirium tremens, 606.

Agar-agar, use of, in constipation accompanying tuberculosis, 505.

AGGLUTINATION REACTION, diagnostic value of, in bacillary dysentery in diagnosis between typhoid and paratyphoid infections, 642.

AGROSTEMMA GITHAGO. *See* Corn cockle.

Air bath. *See* Bath.

AITKEN, on mortality from small-pox before and after vaccination, 93.

ALCOHOL, action of, in diabetes, 744, 757; action of, in obesity, 805; oxidation of, in body, 783; tolerance for fats increased by, 738; use of, as food, 602.

ALCOHOL, contraindications to use of, in chancre of lips, mouth, or tongue, 425; in gout, 698; in intestinal autointoxication, 677; in syphilis, 369.

Alcohol, local use of, in small-pox, 49.

Alcohol, therapeutic use of, in asthenic type of measles, 152; in bacillary dysentery, 227; in barbel cholera, 644; in cerebro-spinal meningitis, 214; in delirium tremens, 603, 607; in diphtheria, 276; in influenza, 90; in night sweats of tuberculosis, 505; in Pasteur treatment of rabies, 339; in pneumonia, 229, 230, 255; in pneumonia of alcoholics, 258; in pneumonia complicating influenza, 192; in Rocky Mountain fever, 566; in scarlet fever, 127; in septicopyemia, 290; in small-pox, 47; in treatment for alcoholism, 598; in tuberculosis, as food, 558; in tuberculosis, as a tonic, 504; in typhoid fever, 14, 23, 26.

ALCOHOLICS, PNEUMONIA IN, 258.

ALCOHOLISM, 587; acute form of, 588; acute hallucinosis due to, 608; atropin and strychnin treatment of, 595, 596; chronic form of, 590; delirium tremens due to, 601; diet in treatment of, 596; dipsomania and, 591, 601; disease in causation of, 590; heredity in causation of, 590; hygienic measures in treatment of, 599; hypnotic suggestion in treatment of, 600; intestinal autointoxication associated with, 683; Keeley gold cure for, 600; Lambert's method of treatment for, 597; McBride's method of treatment for, 595; nervous strain in the causation of, 590; periodic, 591; prophylaxis against, 592; social customs as a predisposing cause of, 590; Town's specific treatment of, 597; treatment of, in general, 593; treatment of, in a sanatorium, 594; types of, 591; varieties of, 587; wood alcohol poisoning and, 609.

ALIMENTARY GLYCOSURIA. See Glycosuria.

Alkalies, administration of, before surgical operations in diabetes, 769; use of, in diabetic acidosis, 756; use of, in diabetic coma, 757.

Alkaline disinfectants, value of, in disinfection for tuberculosis, 452.

Alkaline drinks, use of, in acute phosphorus poisoning, 628.

Alkaline mineral waters, use of, in acute articular rheumatism, 298; in chronic gout, 703; in intestinal autointoxication, 677; in pneumonia of diabetics, 259.

Alkaline sprays, use of, in local treatment of pharyngeal cough, 495.

Alkaline treatment, use of, in acute rheumatism, 30.

Alkaline wash, use of, in laryngeal tuberculosis, 493.

Alkaloids, solanaceous, use of, in treatment of morphinism, 620.

Almateina, use of, for diarrhea in pellagra, 662.

Aloin, belladonna, and strychnin, pills of, as a laxative after hemorrhage in pulmonary tuberculosis, 501.

ALOPECIA, SYPHILITIC, local treatment of, 428.

Alum, external use of, in small-pox, 49; in varicella, 112.

Alypin anesthesia, use of, in treatment of bite by rabid animal, 336.

AMANITA MUSCARIA, 648.

AMANITA PHALLOIDES, 648; poisoning by, 649.

AMANITOTOXIN, 649.

AMENORRHEA, as a symptom of tuberculosis, 507.

AMERICA, introduction of vaccination into, 61.

Ammonia, aromatic spirits of, use of, in bronchopneumonia complicating influenza, 192; in chill accompanying first stage of pneumonia, 254; in scarlet fever, 128.

Ammonia water, local use of, in itching complicating diabetes mellitus, 764.

Ammonium chlorid, use of, in bronchitis complicating influenza, 192; in bronchopneumonia complicating influenza, 189; in lobar pneumonia to keep the urine alkaline, 284; in pulmonary tuberculosis to loosen expectoration, 498.

Ammonium iodid, use of, in syphilis, 409.

Amputation, question of, in diabetic gangrene, 770.

AMUSEMENTS, as a factor in the treatment of tuberculosis, 488.

Amyl nitrate, use of, in pulmonary tuberculosis to control hemorrhage, 500; in tetanus, 348.

AMYLOID DEGENERATION, due to phosphorus poisoning, 630.

ANAPHYLAXIS, associated with gastrointestinal intoxication 682; as explanation of affinity between the skin and putrefac-

- tive substances, 682; following antitoxin treatment of diphtheria, 271.
- ANEMIA**, as a complication of acute rheumatism, 303; as a predisposing cause of rachitis, 814; as a symptom of tuberculosis, 507.
- ANEMIAS**, associated with intestinal auto-intoxication, 680.
- Anesthesia, general**, danger of, in diabetic patients, 769.
- Anesthesia, local**, advantages of, in diabetes mellitus, 770.
- Anesthesia, nitrous-oxid-oxygen**, advantages of, in diabetes mellitus, 770.
- ANGINA, SYPHILITIC**, local treatment of, 426.
- ANILIN DYES**, food poisoning due to, 634.
- ANIMAL ORGANISMS**, food poisoning due to, 634.
- Anisated liquor ammonii**, use of, as an expectorant in pneumonia of children, 257.
- ANOREXIA**, as a symptom of tuberculosis, 504.
- ANTHRAX**, 330; bacteriology of, 330; immunization against, 331; mortality from, affected by serum treatment of, 332; prophylaxis in, 330; serum treatment of, 331; sources of infection in, 330; transmission of, 330.
- Antianthrax serum**, 331; combined method of using, 331; mode of action of, 332; mortality of anthrax affected by use of, 332; production of, 331; technique of, 332.
- Antidiphtheritic serum**, use of, in treatment of whooping-cough, 179.
- Antiinfluenza serum**, 194, 210.
- Antimeningitic serum**, use of, in cerebrospinal meningitis, 200; dose of, 205; frequency of administration of, 206; indications for use of, 204; nature of, 200; technique of administration of, 205; treatment of chronic cases of cerebrospinal meningitis with, 209; treatment of resistant cases with, 208; treatment of prolonged cases with, 207; treatment of relapses with, 207.
- Antipneumococcus serum**, 238; dose of, 240; prophylactic uses of, 240; therapeutic results of, 239, 240.
- Antipyrin**, use of, in acute gout, 703; in acute polymyositis, 685; in acute rheumatism, 300; in the asthenic form of measles, 154; in diabetic neuralgia and neuritis, 766; in laryngismus stridulus complicating rachitis, 820; in measles, 150, 151, 152, 153; in mumps, 170; in neuralgia complicating acute rheumatism, 304; in Rocky Mountain fever, 565; in scarlet fever, 126; in small-pox, 47; in varicella, 111, 113; in whooping-cough, 181.
- Antipyrin**, hypodermic use of to relieve muscular pain in Weil's disease, 573.
- Antirabic serum**, 339.
- Antiseptics, intestinal**, use of, in enterocolitis complicating measles, 160; in intestinal autoinoculation, 674; unsatisfactory in chronic stage of bacillary dysentery, 328.
- Antistreptococcic serum**, injection of, for control of hemorrhage in hemorrhagic measles, 155; in scarlet fever complicated by sepsis, 128.
- Antitoxic serum**, use of, in meat poisoning due to *Bacillus botulinus*, 639; use of, in whooping-cough, 183.
- Antitoxin of diphtheria**, use of, in diphtheria, 269; in laryngeal complications of measles, 157; in pneumonia, 240; in typhus fever, 37.
- Antitoxin of tetanus**, 344; administration of, in doubtful cases, 351; dose of, 346; mode of administering, 345; results of, 350; rules for use of, 350; single or double doses of, 346.
- Antitoxin treatment of diphtheria**, 269; anaphylaxis following, 271; dose of antitoxin in, 269; eruptions following, 271; indications for employing, 267; mode of injecting, 270; in post-diphtheritic paralysis, 278; site of injection for, 270.
- ANTITUBERCULOSIS SOCIETIES**, work done by, in prevention of tuberculosis, 451.
- ANTITUBERCULOSIS WORK**, 440; in Denmark, 442; in the District of Columbia, 444; in England, 440; in France, 442; in Germany, 441; in Ireland, 441; in Massachusetts, 445; in Michigan, 446; in New Jersey, 446; in New York City, 447; in Pennsylvania, 446; in Scotland, 440; by societies, 451; in the United States, 443.
- ANTITYPHOID VACCINATION**, 3; objects of, 6; results of, 4; use of sera in, 7; technique of, 6; use of, in typhoid carriers, 6.

- Aspiration**, in diagnosis of empyema accompanying tuberculosis, 507; for relief of pleural effusion accompanying tuberculosis, 507; for relief of pneumothorax in tuberculosis, 507.
- Aspirin**, use of, in acute gout, 703; in acute rheumatism, 300; in acute scarlatinal arthritis, 305; in "colds" accompanying tuberculosis, 508; in diabetes mellitus, 760; in influenza, 187; in measles, 151; in neuralgia complicating acute rheumatism, 304; in pneumonia, 226; in polymyositis, 685; in Rocky Mountain fever, 564; in septicopyemia, 291; in Weil's disease, 572.
- Astringents**, use of, in diarrhea of pellagra, 662; in enterocolitis complicating measles, 160; in hemorrhagic form of measles, 154, 155; in stomatitis of pellagra, 662; unsatisfactory in chronic stage of bacillary dysentery, 328.
- Atophan**, use of, in acute gout, 702.
- Atoxyl**, hypodermic administration of, a necessity, 660; optic nerve atrophy from use of, 660; use of, in pellagra, 659; use of, in syphilis, 412.
- Atoxyl and thioglycolic acid**, use of, in combination in treatment of hydrophobia, 343.
- Atropin**, use of, in acute opium poisoning, 615; in cardiac failure in pneumonia, 193; in cardiac toxemia of pneumonia, 251; in chronic opium poisoning, 620; in "colds" accompanying tuberculosis, 508; in diabetes mellitus, 759; by instillation, in care of eyes in small-pox, 50; in muscarin poisoning, 648; in night sweats of tuberculosis, 505; in poisoning by amanita phalloides, 649; for ptialism, in mumps, 171; in pulmonary edema complicating pneumonia, 259; symptoms due to misuse of, in whooping-cough, 175; in syphilitic iritis, 429; in tetanus, 348.
- Atropin, combined with strychnin**, use of, in treatment of alcoholism, 596.
- Atropin, combined with strychnin and digitalin**, use of, in delirium tremens, 604.
- ATWATER AND BENEDICT**, value of alcohol in sparing fats and carbohydrates demonstrated by, 558.
- AUDAUT**, oil of turpentine recommended by, in phosphorus poisoning, 628.
- AUDRY**, administration of mercury by rectum advocated by, 387.
- AUSTRIA**, introduction of vaccination into, 60.
- AUTOINOCULATION**, generalized vaccinia from, 82.
- AUTOINOCULATION IN TUBERCULOSIS**, 525; control of, 526; exercise in relation to, 527; rest in relation to, 528, 529.
- AUTOINTOXICATION, INTESTINAL**. *See* Intestinal autointoxication.
- AUTOLYZED PNEUMOCOCCI**. *See* Pneumococci.
- Bacelli's method of treating tetanus**, 349.
- BACILLEN EMULSION, KOCH'S**. *See* Koch.
- BACILLUS ANTHRACIS**, meat poisoning caused by, 643.
- BACILLUS BOTULINUS**, MEAT POISONING DUE TO, 638; symptoms of, 639; treatment of, 639.
- BACILLUS BRESLAVIENSIS**, meat poisoning due to, 641.
- BACILLUS BULGARICUS**, intestinal putrefaction treated by cultures of, 671.
- BACILLUS ENTERITIDIS**, MEAT POISONING DUE TO, 640; treatment of, 641.
- BACILLUS OF INFLUENZA**, discovery of, 184; endocarditis caused by, 193; meningitis caused by, 193; pure culture of, obtained from an appendiceal abscess, 190.
- BACILLUS PARATYPHOSUS**, epidemics of fish poisoning due to, 644; meat poisoning caused by, 642.
- BACILLUS PISCICIDUS AGILIS**, epidemic among fish due to, 644.
- BACILLUS PNEUMONIÆ**, meat poisoning caused by, 643.
- BACILLUS PROTEUS VULGARIS**, epidemic among fish caused by, 644; meat poisoning caused by, 642.
- BACILLUS SALMONICIDA**, epidemic among trout due to, 644.
- BACILLUS SCARLATINÆ**, 114.
- BACILLUS SUISEPTICUS**, meat poisoning due to, 642.
- Bacon**, use of, in diabetes mellitus, 744.
- BACTERIAL DISINTEGRATION OF FOOD**, abnormal products of intestinal autointoxication due to, 667; normal products of, 667.
- Balsam of Peru**, use of, to relieve itching in varicella, 113.

- Balsamics**, inhalation of, for relief of gangrene of the lung complicating pneumonia, 261.
- Bandaging**, use of, in phlebitis during typhoid fever, 28.
- BARBEL CHOLERA**. *See* Cholera.
- BARDSWELL**, scheme devised by, to supply variety of diet in tuberculosis, 547.
- Basham's mixture**, use of, in nephritis complicating influenza, 194; in nephritis complicating scarlet fever, 134.
- "Bath, air,"** use of, to reduce temperature in pneumonia, 231.
- Bath, alcohol sponge**, use of, to relieve night sweats in tuberculosis, 505.
- Bath, arsenic**, use of, in pellagra, 662.
- Bath, cold sponge**, therapeutic use of, in bacillary dysentery, 324; in measles, 149; in meat poisoning, 639; in pneumonia, 233; in Rocky Mountain fever, 565; in scarlet fever, 125; in typhoid fever, 18; in Weil's disease, 572.
- Bath, cold tub**, therapeutic use of, contraindicated, in diabetes mellitus, 762; contraindicated in influenza, 188; in erysipelas, 284; in intestinal autoinfection, 677; in measles, 149; in pellagra, 662; in pneumonia, 232; in scarlet fever, 126; in septicopyemia, 290; in small-pox, 47; in treatment of obesity, 808; in typhoid fever, 16.
- Bath, cool sponge**, therapeutic use of, contraindicated in cerebrospinal meningitis, 213; in infantile diarrhea, 329.
- Bath, electric light**, therapeutic use of, in arthritis deformans, 713.
- Bath, fan**, therapeutic use of, in typhoid fever, 16.
- Bath, hot air**, therapeutic use of, in nephritis complicating scarlet fever, 133, 134; in treatment of morphin addiction, 624.
- Bath, hot foot**, use of, to relieve "colds" accompanying tuberculosis, 568.
- Bath, hot sponge**, therapeutic use of, in pneumonia, 231, 298.
- Bath, hot tub**, therapeutic use of, in acute alcoholism, 589; in after-treatment of morphin addiction, 624; in arthritis deformans, 712; in the asthenic form of measles, 154; in cerebrospinal meningitis, 213; in chronic opium poisoning, 619; in measles, 150; in pellagra, 662; in nephritis complicating scarlet fever, 133; in pneumonia, 233; in Rocky Mountain fever, 566; in wood alcohol poisoning, 610.
- Bath, permanent**, use of, in arthritis deformans, 713.
- Bath, salt**, use of, in arthritis deformans, 712, 713; in rachitis, 816.
- Bath, sulphur**, use of, in pellagra, 662.
- Bath, tepid sponge**, therapeutic use of, in erysipelas, 284; in infantile diarrhea, 329.
- Bath, tepid tub**, therapeutic use of, in infantile diarrhea, 239; in measles, 149; in varicella, 111.
- Bath, Turkish**, therapeutic use of, in acute alcoholism, 589; in arthritis deformans, 713; in syphilis, 365; in treatment of morphin addiction, 624.
- Bath, vapor**, therapeutic use of, for elimination of toxic substances in intestinal autointoxication, 672; in nephritis complicating scarlet fever, 133, 134.
- Bath, warm salt**, use of, locally in arthritis deformans, 712, 713.
- Bath, warm tub**, therapeutic use of, in arthritis deformans, 713; in cerebrospinal meningitis, 213; in delirium tremens, 602; in diabetes mellitus, 762; in nephritis complicating scarlet fever, 133; in paralysis following meningitis, 214; in scarlet fever, 125; in small-pox, 47; in syphilis, 365.
- Baths, medicated**, use of, in pellagra, 662.
- Baths, mercurial**, use of, in hereditary syphilis, 433; in syphilis, 389.
- Baths, neutral**, use of, to relieve nervous symptoms in intestinal autointoxication, 673.
- BAVARIA**, introduction of vaccination into, 61.
- Béck's bismuth paste**, injection of, in treatment of fistulæ complicating tuberculosis, 509.
- BED**, arrangement of, in bacillary dysentery, 324.
- BEDSORES**, treatment of, in typhoid fever, 11; treatment of, in typhus fever, 38.
- BEDDING**, care of, in tuberculosis, 467.
- Beef and pancreas infusion**, use of, in diabetes mellitus, 761.
- Beef juice**, use of, for anemia accompanying rachitis, 818.
- BELGIUM**, introduction of vaccination into, 60.

- Belladonna**, use of, in cardiac toxemias of pneumonia, 251; in enterocolitis complicating measles, 161; in prevention of scarlet fever, 123; to relieve "colds" accompanying tuberculosis, 508; to relieve cough in measles, 153; to relieve sciatic pain in diabetes mellitus, 766; symptoms due to use of, in whooping-cough, 175.
- Belladonna**, combined with iodine, use of, to counteract its ill effects, 406.
- Belladonna**, combined with xanthoxylum and hyoscyamus, use of, in treatment of alcoholism, 598; in treatment of morphinism, 621.
- Belladonna fomentations**, use of, in adenitis, accompanying glandular fever, 576.
- Belladonna ointment**, use of, in mumps, 170, 171.
- Benzoic acid**, use of, with camphor in pneumonia of young children, 254.
- Benzoin**, compound tincture of, use of, in bronchorrhea complicating pneumonia, 261; in inflammation of larynx in small-pox, 51; for relief of cough in pneumonia, 257; for relief of gangrene of the lung complicating pneumonia, 261; in respiratory type of influenza, 189.
- Benzosol**, use of, in enlargement of lymphatic glands complicating measles, 162.
- BERGHAUSEN**, rules suggested by, for prevention of tetanus, 350.
- BERLIN**, mortality from small-pox in, before and after vaccination, 99.
- Beta-naphthol**, use of, as an antiseptic in intestinal autointoxication, 675; in diarrhea complicating septicemia, 291; in enterocolitis complicating measles, 161; in typhoid fever, 26.
- BETA-OXYBUTYRIC ACID**, relation of, to diabetes mellitus, 731; test for, in urine, 733.
- Bichlorid of mercury**. *See* Mercury bichlorid.
- Bier's method of artificial hyperemia**, use of, in arthritis deformans, 712; in erysipelas, 285; in gonococcic arthritis, 307; for relief of boils in diabetes mellitus, 765.
- BIGGS, DR. HERMAN**, antituberculosis work done by, 448.
- BILIOUS PNEUMONIA**. *See* Pneumonia.
- Binz**, on effect of alcohol on temperature of the body, 230.
- Bismuth**, use of, combined with opium, to relieve pain in meat poisoning due to the *Bacillus enteritidis*, 641; combined with sodium bicarbonate, and nuxvomica, in delirium tremens, 602.
- Bismuth, subcarbonate**, use of, in typhoid fever, 26.
- Bismuth subgallate**, use of, in enterocolitis complicating measles, 161.
- Bismuth, subnitrate**, use of, as an antiseptic in intestinal autoinoculation, 675; in chronic stage of bacillary dysentery, 328; for diarrhea in pellagra, 662; for diarrhea complicating septicopyemia, 291; for diarrhea accompanying tuberculosis of the intestines, 505; as dusting powder in diabetic vulvitis, 765; in enterocolitis complicating measles, 160; in gastrointestinal type of influenza, 190; in infantile diarrhea, 329.
- "Black measles,"** 154.
- Black wash**, use of, in chancre of the vagina or uterine neck, 425; in exulcerated chancre, 423; as gargle, in chancre of the mouth, lips, or tongue, 425; in secondary syphilis of the mucosæ and mucocutaneous surfaces, 426.
- Blanket pack**. *See* Pack.
- BLEEDERS**, vaccination contraindicated in case of, 74.
- BLINDNESS**, due to wood alcohol poisoning, 610.
- Blister, fly**, use of, in syphilitic iritis, 429.
- BLOOD**, changes in, due to rachitis, 818.
- BLUE BOOK ON VACCINATION, THE**, 59.
- BODENHAMER'S RECTAL IRRIGATORS**, 674.
- BODY WEIGHT**, average, at different ages, 782; secretion of sexual glands in relation to, 786.
- BOHEMIA**, mortality from small-pox in, before and after vaccination, 99.
- BOILS**, accompanying diabetes mellitus, 765.
- BOIX**, experiments by, on cause of atrophic cirrhosis of the liver, 679.
- BONES, SYPHILITIC LESIONS OF**, local treatment of, 430.
- Borax**, use of, to relieve itching in chicken-pox, 112.
- Boric acid**, injections of, in chancre with phimosis, 423; irrigations of, in abscess cavity in cervical glands in diphtheria, 278; use of, in varicella, 113; wet compresses of, in inflamed chancre, 422.

- Boric acid mouth wash**, use of, in measles, 148; in mumps, 176.
- BOUCHARD**, autointoxication attributed by, to dilatation of the stomach, 678.
- Bouchard's method**, for reduction of obesity, 794.
- Bouillon filtrate**, Denys. *See* Denys.
- BOWELS**, management of, in typhoid fever, 25. *See also* Intestines.
- "BOX SYSTEM,"** employment of, in scarlet fever, 122.
- BRACHIAL NEURITIS**. *See* Neuritis.
- BRADYCARDIA**, as a complication of pneumonia, 260.
- BRAMWELL, DR. MILNE**, statistics published by, on results of hypnotic suggestion on alcoholism, 600.
- BRAND**, use of hydrotherapy in treatment of general infections introduced by, 16.
- BRAUER**, "open method" of producing artificial pneumothorax in tuberculosis devised by, 534.
- BREAD**, use of, in diabetes mellitus, 746.
- BREAST-FEEDING**, importance of, in prophylaxis against rachitis, 815; importance of, in prophylaxis against tuberculosis, 456.
- BREHMER**, hygienic-dietetic treatment of tuberculosis inaugurated by, 477.
- BROADBENT, SIR WILLIAM**, use of cold affusion in delirium tremens recommended by, 606.
- Bromid of ammonium**, use of, in treatment of morphinism, 620.
- Bromid of potassium**, use of, in tetanus, 348.
- Bromid of sodium**, use of, in measles, 152; for relief of headache in erysipelas, 284; in treatment of morphinism, 620; in varicella, 113.
- Bromid of strontium**, use of, to relieve hic-cough complicating pneumonia, 260.
- Bromids**, use of, for convulsions in rachitis, 819; in delirium tremens, 606; before intubation in diphtheria, 275; in mumps, 170; to relieve pain in Rocky Mountain fever, 564; to relieve spasmodic croup in measles, 153; in scarlet fever, 127.
- Bromids**, use of, by rectum, in cerebrospinal meningitis, 214; in hydrophobia, 342.
- Bromids**, use of, for insomnia, in acute rheumatism, 302; in diabetes insipidus, 775; in septicopyemia, 291; in tuberculosis, 507; in typhoid fever, 26.
- Bromoform**, method of administering, 182; use of, in whooping-cough, 181.
- BRONCHIECTASIS**, as a complication of influenza, 194; treatment of, 194.
- BRONCHITIS**, complicating influenza, 189; complicating measles, 153; complicating Rocky Mountain fever, 565; complicating tuberculosis, 507; complicating whooping-cough, 175; treatment of, in whooping-cough, 181.
- BRONCHOPNEUMONIA**, as a complication of diphtheria, 278; as a complication of influenza, 191; as a complication of measles, 158; as a complication of whooping-cough, 175.
- BRONCHORRHEA**, as a complication of pneumonia, 261.
- BROSCH**, case of poisoning from oysters reported by, 645.
- BROUARDEL**, early use of steam for disinfection by, 579.
- BROWN, LAWRASON**, cases of tuberculosis considered suitable for sanatorium treatment by, 470.
- BRYSON**, poisoning from use of mutton reported by, 638.
- BUCCAL ACCIDENTS**, due to hydrargyrisms, 384.
- BUCKEYE**, poisoning by, 651.
- BUFFALO GNAT**. *See* Simulium reptans.
- Burow's solution**, use of, in inflamed chancre, 422.
- BURTON**, on stenosis of salivary duct in mumps, 171.
- BUTTER**, use of, in diabetes mellitus, 743.
- BUTTERMILK, FAT-POOR**, use of, in acidosis of children, 757.
- Cactus**, use of, in diphtheria, 277.
- CADAVÉRIN**, isolation of, from *B. piscicidus agilis*, 644.
- Caffein**, use of, in acute alcoholism, 589; in acute opium poisoning, 615; in the asthenic form of measles, 153; in barbel cholera, 644; in bronchopneumonia complicating influenza, 192; in cardiac toxemias of pneumonia, 255; in cerebrospinal meningitis, 214; in cheese poisoning, 647; in delirium tremens, 605; in diphtheria, 277; in erysipelas, 284; in influenza, 187; in pneumonia, 235; in poisoning by *amanita phalloides*, 649; in poisoning by wood alcohol, 610; in

- scarlet fever with cardiac weakness, 127;
in septicopyemia, 610.
- Calabar bean**, use of, in tetanus, 348.
- CALCIUM**, deficiency of, in causation of rachitis, 813.
- Calcium chlorid**, use of, in hematuria complicating scarlet fever, 134.
- Calcium iodid**, use of, in syphilis, 409.
- Calcium lactate**, use of, for control of hemorrhage in pulmonary tuberculosis, 500.
- Calomel as dusting powder**, use of, in diabetic vulvitis, 765; in exulcerated chancre, 423; in mucous patches on the genitalia, 427; in secondary syphilitic cutaneous lesions of the face, 425; in syphilitic condylomata, 428; in uncomplicated chancre, 422.
- Calomel as an insoluble injection**, in syphilis, 396.
- Calomel, internal use of**, in acute gout, 703; in acute rheumatism, 298; in bacillary dysentery, 326; in constipation accompanying tuberculosis, 504; in diarrhea of septicopyemia, 291; in glandular fever, 576; in infantile diarrhea, 329; in influenza, 187; in intestinal auto-intoxication, 672; in meat poisoning from *B. botulinus*, 639; in meat poisoning from *B. paratyphosus*, 642; in pneumonia, 227; in syphilis, 388; in typhoid fever, 25.
- Calomel, vaginal tampons impregnated with**, in chancre of the vagina and uterine neck, 425.
- Calomel, combined with sodium bicarbonate**, use of, in acute alcoholism, 589; in chronic alcoholism, 595; in delirium tremens, 602; in Rocky Mountain fever, 564.
- Calomel ointment**, use of, in chancre of the integument, 425; in chancre of the lips, 425; in exulcerated chancre, 423; by inunction in prophylaxis of syphilis, 373; in syphilitic alopecia, 429.
- Calomel suppositories**, use of, in rectal chancre, 424.
- CALORIC NEEDS**, in diabetes mellitus, 737.
- Camphor**, use of, in acute opium poisoning, 615; in barbel cholera, 644; in collapse during pneumonia, 327; in delirium tremens, 605; in diphtheria, 277; in erysipelas, 284; in pneumonia, 235; in pneumonia with cardiac failure, 253; in poisoning by *amanita phalloides*, 649; to raise blood pressure, 255; in scarlet fever with cardiac weakness, 127; in septicemia, 291; in typhoid fever, 23; in whooping-cough, 181.
- Camphor, subcutaneous injections of**. *See* Injection.
- Camphor oil**, use of, in asthenic form of measles, 154; hypodermic, in septicemia, 291.
- Camphorated sterile oil**, use of, in pneumonia, 235.
- Camphoric acid**, use of, to relieve night sweats in tuberculosis, 505.
- CANE-SUGAR**. *See* Saccharose.
- CANNED FISH**, poisoning due to, 645.
- CANNED MEAT**, poisoning by *B. enteritidis* caused by, 640.
- Cannabis indica**, use of, in after-treatment of morphinism, 624.
- CARBOHYDRATE EQUIVALENTS IN FOOD**, 740.
- CARBOHYDRATE METABOLISM**, relation between, and diabetes mellitus, 720.
- CARBOHYDRATES**, extra supply of, needed in food during convalescence from pneumonia, 262; function of, 782; as source of fat, 783; as source of heat and energy, 782; sugar derived from, 782; in treatment of acidosis, 756.
- Carbolic acid**, use of, for irrigating an abscess cavity in cervical adenitis complicating diphtheria, 277; to relieve itching in varicella, 112; in treatment of scarlet fever, 120.
- Carbolic acid and water**, use of, as spray in small-pox, 49.
- Cardamom, compound tincture of**, use of, in pneumonia, for relief of gas accumulated in the stomach, 260; for relief of hic-cough, 260.
- CARDIAC TOXEMIAS**, blood pressure affected by, in pneumonia, 254; treatment of, in pneumonia, 246; vasomotor centers in spinal cord affected by, 247.
- CARDIAC WEAKNESS**, as a complication of scarlet fever, 127.
- CARDIO-CIRCULATORY DISTURBANCES**, as a complication of influenza, 193.
- CARDIOVASCULAR LESIONS**, presence of, in gout, 695.
- CARLSBAD**, treatment at, beneficial to brachial neuritis accompanying diabetes mellitus, 766.

- "CARRIERS," of dysentery, 320; of pneumonia, 222; of typhoid fever, 2, 6, 9.
- Cascara sagrada**, use of, in constipation of tuberculosis, 505; after hemorrhage in pulmonary tuberculosis, 501.
- CASSAVA ROOT**, poisoning by, 650.
- CASTELLOI**, investigations by, on treatment of typhus fever, 37.
- Castlebury method**, of feeding diphtheria cases after intubation, 276.
- Castor oil**, use of, in bacillary dysentery, 326; in barbel cholera, 644; in diarrhea accompanying septicemia, 291; in diarrhea accompanying tuberculosis, 505; in infantile diarrhea, 329; in Lambert's method of treating alcoholism, 598; in Lambert's method of treating morphinism, 623; in meat poisoning due to *B. paratyphosus*, 642; in muscarin poisoning, 648.
- CASTOR OIL BEAN**, proteid character of poisonous elements in, 635.
- CATARACT**, accompanying diabetes mellitus, 767.
- Cathartics**, use of, in enterocolitis complicating measles, 160; in gastric irritability of septicemia, 291; of doubtful benefit in intestinal autointoxication, 671; in treatment of obesity, 810.
- Cathartics, saline**, use of, in acute gout, 703; in acute rheumatism, 298; in barbel cholera, 644; in delirium tremens, 602; in diabetes mellitus, 736; in influenza, 187; in intestinal autointoxication, 672; in Lambert's method of treating alcoholism, 597, 598; in meat poisoning due to *B. botulinus*, 639; in meat poisoning by *B. enteritidis*, 641; in meat poisoning due to *B. paratyphoides*, 642; in mumps, 170; in muscarin poisoning, 648; in nephritis complicating scarlet fever, 133, 134; in phosphorus poisoning, 628; in pneumonia, 227.
- Cathartics, vegetable**, use of, contraindicated in intestinal autointoxication, 672.
- Caustic potash**, use of, in treatment of anthrax, 333.
- CAUSTIC SODA**, as a disinfectant for tuberculosis, 453.
- Cauterization**, of accidental syphilitic lesions, 375; of bite by rabid animal, 336; of mucous patches, 427; of sloughing tonsils complicating scarlet fever, 130; of syphilitic onychia, 429.
- Cautery, actual**, use of, in gangrenous or phagedenic chancre, 423; in laryngeal tuberculosis, 493; results of, in treatment of bite by rabid animal, 336; in syphilitic onychia, 429; in ulceration of cornea in small-pox, 50.
- Cautery, Paquelin**. *See* Paquelin.
- CEREBRAL HEMORRHAGE**, as a complication of whooping-cough, 175.
- CEREBROSPINAL MENINGITIS**, 199; definition of, 199; diagnosis of, 200, 201; diagnosis between, and typhus fever, 39; diet to be employed in, 212; drugs in treatment of, 213; epidemic form of, 200; etiology of, 199; gavage in treatment of, 212; influenzal form of, 210; organisms causing, 199; pneumococcus form of, 210; serum treatment in, 200; prophylaxis of, 211; staphylococcus form of, 211; streptococcus form of, 210; symptomatic treatment of, 213; treatment of, in general, 212; tuberculous form of, 209.
- CEREBROSPINAL MENINGITIS, EPIDEMIC**, 200; diagnostic inferences from lumbar puncture in, 204; indications for lumbar puncture in, 202; technique of lumbar puncture in, 202; serum treatment of, 200; urotropin treatment for, 213.
- CERVICAL ADENITIS**. *See* Adenitis, cervical.
- CHAIR**, for use in active stage of tuberculosis, 485.
- CHAMOT**, statistics of phosphorus poisoning published by, 626.
- CHANCRE**, excision of, 377; method employed for, 378.
- CHANCRE**, local treatment of, 422: of chancre of general integument, 425; of chancre of the lips, mouth, or tongue, 425; of chancre with paraphimosis, 424; of chancre with phimosis, 423; of chancre of the vagina and uterine neck, 425; of exulcerated chancre, 422; of gangrenous or phagedenic chancre, 423; operative measures in gangrenous or phagedenic chancre, 423; operative measures in urethral chancre, 424; of rectal chancre, 424; of urethral chancre, 424.

- CHARRIN**, isolation of microorganisms pathogenic for fish by, 644.
- CHEADLE, DR.**, summary by, of evidence for supposing acute rheumatism to be an infection, 295.
- CHEESE**, use of, in diabetes mellitus, 743.
- CHEESE POISONING**, 647.
- Chekan**, use of, for relief of bronchorrhea complicating pneumonia, 261.
- CHEMNITZ**, mortality in, from small-pox, during epidemic in 1870, 102.
- Chemoimmunology**, use of, in treatment of pneumonia, 245.
- CHICKENPEA**, poisoning by. *See* Lathyrism.
- CHICKEN-POX**. *See* Varicella.
- CHILDREN**, diabetes in, 768; prophylaxis against obesity in, 787; protection of, against tuberculosis, 458; treatment of obesity in, 787.
- CHILL**, as symptom of pneumonia, 226; as symptom of typhus fever, 35.
- CHIN-COUGH**. *See* Whooping-cough.
- CHINESE**, infrequency of typhoid among, 2; inoculation for small-pox practiced among, 52.
- Chloral hydrate**, use of, in after-treatment of morphinism, 624; in cerebrospinal meningitis, 214; contraindications to, in alcoholism, 595; in delirium of pneumonia, 228; in delirium tremens, 606; in measles, 152; in pneumonia of alcoholics, 258; for relief of convulsions in rachitis, 819; for relief of insomnia in erysipelas, 284; for relief of insomnia in typhoid fever, 26; in scarlet fever, for prevention of nephritis, 133.
- Chloral hydrate**, use of, by rectum, in hydrophobia, 342; in laryngismus stridulus complicating tetanus, 820.
- Chloralamid**, use of, in nervous type of influenza, 191.
- Chlorate of potash**. *See* Potassium chlorate.
- Chloretone**, cases of tetanus treated by, in combination with antitoxin, 354; use of, in tetanus, 348.
- Chloric ether**, use of, in pneumonia, to relieve accumulation of gas in the stomach, 260.
- CHLORINATED LIME**, as a disinfectant in tuberculosis, 453, 458.
- CHLORINATED SODA**, as a disinfectant in tuberculosis, 453.
- Chloroform**, inhalation of, in convulsions from acute alcoholism, 589; in cough of tuberculosis, 498; in laryngismus stridulus complicating rachitis, 820; in paroxysms of hydrophobia, 342; in tetanus, 348, 352; in whooping-cough, 180.
- Chloroform anesthesia**, use of, in cauterization of wounds made by rabid animals, 336.
- Chloroform liniment**, use of, to relieve pain in the chest accompanying tuberculosis, 506.
- CHLOROFORM POST-ANESTHETIC POISONING**, association of, with autointoxication, 683.
- CHOLECYSTITIS**, as complication of typhoid fever, 28; due to influenza bacillus, 190.
- CHOLIN**, as a cause of food poisoning, 635.
- CHOREA**, as a complication of acute rheumatism, 304.
- Chromic acid**, external use of, in mucous patches, 427; in stomatitis due to hydrargyrisms, 385; in tertiary syphilitic lesions of mucous and mucocutaneous surfaces, 427.
- CHVOSTEK'S SYMPTOM**, in tetany complicating rachitis, 819.
- CIRCULATION, DISORDERS OF**, associated with intestinal autointoxication, 679; due to use of arsenobenzol in syphilis, 415; in typhoid fever, 23.
- CIRCUMCISION**, performance of, in excision of chancre, 378.
- CICUTA MACULATA**. *See* Cicut roots.
- CICUTA ROOTS**, poisoning by, 650.
- Citrate of magnesium**. *See* Magnesium citrate.
- Citrin ointment**, use of, in syphilitic onychia, 429.
- CLAVICEPS PURPUREA**, ergotism due to, 652.
- CLIMATES BENEFICIAL IN TUBERCULOSIS**, 474.
- Climatic treatment**, in convalescence from pneumonia, 262; in tuberculosis, 472.
- CLOTHING**, choice of, in tuberculosis, 489; disinfection of, in tuberculosis, 467.
- Clysmas**, administration of medicines by, in acute rheumatism, 299.
- Coal-tar products**, conditions contraindicating, in pneumonia, 246; conditions contraindicating, in typhoid fever, 26; introduction of, into medicine, 16; symp-

- toms due to misuse of, in whooping-cough, 175; use of, for relief of headache in typhoid fever, 27; use of, for relief of sciatic pain in diabetes mellitus, 766; use of, in treatment of scarlet fever, 127.
- Cocain**, use of, in acute opium poisoning, 615; in chancre with paraphimosis, 424; as mouth wash in stomatitis accompanying hydrargyrisms, 385; for otitis complicating scarlet fever, 131; for relief of gastric irritability in typhoid fever, 25; in small-pox accompanied by dysphagia, 47; in tertiary syphilitic lesions of the mucous and mucocutaneous surfaces, 427; in whooping-cough, 182.
- Cocain anesthesia**, use of, in excision of chancre, 378; in treatment of bite from rabid animal, 336.
- COCAINISM**, Town's specific treatment for, 597.
- Codein**, use of, in bronchitis complicating influenza, 189; in chronic opium poisoning, 620; contraindicated in chronic bronchiectasis complicating influenza, 195; to control cough in the active stage of tuberculosis, 482; to control cough in laryngeal tuberculosis, 498; in diabetes mellitus, 759; in laryngismus stridulus complicating rachitis, 820; in mumps, 170; for relief of cough in measles, 153; for relief of pain and cough in pneumonia, 226; for relief of pain in small-pox, 47; to restrain delirium in pneumonia, 228; substitution of, for morphin, in treatment of morphinism, 618; in varicella, 113; in whooping-cough, 181.
- Codein, in combination with ammonium chlorid**, use of, for relief of cough in pneumonia, 257.
- Cod liver oil**, use of, in convalescence from pneumonia, 262; for enlargement of the lymphatic glands complicating measles, 162.
- Cod liver oil, combined with phosphorus**, use of, in rachitis, 817.
- Coffee**, administration of, by rectum in pneumonia with marked cardiac depression, 230, 249.
- Coffee, strong**, use of, in acute opium poisoning, 615; in diet of pneumonia, 230; in septicopyemia, 291.
- COHEN**, directions by, for use of quinin and urea hydrochlorid in pneumonia, 235.
- Colchicum**, use of, in acute gout, 702.
- COLD-STORAGE SYSTEM**, risk of food poisoning from, 637.
- COLEMAN, WARREN**, studies of diet in typhoid fever by, 13.
- COLITIS, MUCOMEMBRANOUS**, due to auto-intoxication associated with habitual constipation, 678.
- Collargolum**, use of, in suppository form, in polymyositis, 685; subcutaneous injections of, in typhus fever, 37.
- COLLES-BAUMÉS LAW**, 433.
- Collodion, flexible**, use of, in cervical adenitis complicating scarlet fever, 131.
- Coloclyster**, use of, in intestinal auto-intoxication, 673.
- Colonic flushing**, use of, in arthritis associated with intestinal autointoxication, 681; in chronic intestinal autotoxemia, 672; in infantile diarrhea, 329; in septicemia, 290, 291; in tuberculosis of intestines, 505.
- Colonic irrigation**. *See* Colonic flushing.
- COLUMBIAN SPIRITS**. *See* Wood alcohol.
- COMA, DIABETIC**. *See* Diabetic coma.
- COMBY**, case cited by, of mumps during pregnancy and in child at birth, 167.
- Compound cathartic pills**, use of, in treatment of chronic alcoholism, 598; use of, in treatment of morphinism, 621.
- Compound licorice powder**, use of, after hemorrhage in pulmonary tuberculosis, 501.
- Compound mustard liniment**, use of, for relief of pain and cough in pneumonia, 227.
- Compound spirits of ether**, in cardiac failure complicating influenza, 193; in delirium of pneumonia, 254; in pneumonia, with cardiac toxemia, 254; for relief of gas in stomach, during pneumonia, 260; for relief of hiccup, 260.
- Compound spirits of lavender**, use of, in pneumonia with cardiac toxemia, 254.
- Compress, cold**, use of, in acute gout, 702; in adenitis accompanying glandular fever, 576; to reduce temperature, in pneumonia, 233; to relieve night sweats in tuberculosis, 505.
- Compress, hot wet**, use of, to relieve pain in brachial neuritis accompanying diabetes mellitus, 766.
- Compressed air**, inhalation of, in treatment of whooping-cough, 179.

- CONDYLOMA LATUM**, local treatment of, 428.
Conium, use of, in tetanus, 348.
CONJUNCTIVA, incision of, in care of eyes during small-pox, 50.
Constant current, use of, for paralysis accompanying meat poisoning, 640.
CONSTIPATION, accompanying tuberculosis, 504; association of, with intestinal auto-inoculation, 677; diet for, in advanced cases, 555.
Constitutional treatment of syphilis, 416.
Continuous intermittent treatment, administration of mercury by, in syphilis, 418.
Continuous treatment, administration of mercury by, in syphilis, 417.
"CONTROLLED AUTOINOCULATION," 526.
CONVEYANCES, disinfection for tuberculosis in, 454.
CONVULSIONS, rachitis a cause of, in infancy, 819; treatment of, in cerebro-spinal meningitis, 214.
Copper sulphate, use of, in treatment of acute phosphorus poisoning, 627.
CORN, association of, with pellagra, 657.
CORN COCKLE, poisoning by, 651.
CORNEA, ULCERATION OF, in small-pox, 50.
CORPORATIONS, disinfection in tuberculosis, and, 453.
Corrosive sublimate. *See* Mercury bichlorid.
CORY, DR., vaccination by, with virus from syphilitic patient, 88.
CORYZA, accompanying tuberculosis, 507.
Coto, fluid extract of, use of, to diminish hyperacidity, 672.
COUGH IN PNEUMONIA, 226, 257.
COUGH IN PULMONARY TUBERCULOSIS, 495; causes of, 495; control of during active stage, 482; control of, in laryngeal complications, 491, 498; local measures for relief of, 497; prophylactic measures for relief of, 496; sedative drugs for relief of, 497; suppression of, 496; varieties of, 495.
COUNCILMAN, studies by, on small-pox organisms, 41, 104.
Counterirritation, use of, in arthritis deformans and chronic rheumatism, 712; in bronchopneumonia complicating measles, 159; in muscular rheumatism, 689; for relief of cough in tuberculosis, 497; for relief of endocarditis complicating pneumonia, 261; for relief of pain in the chest in tuberculosis, 506; of no value in cerebrospinal meningitis, 213.
COW-POX, 56.
CRANIOTABES, 817.
Cream, use of, in diabetes mellitus, 743.
CREATININ, excretion of, in pneumonia, 229.
Creolin, irrigation of the bowel with a solution of, in the chronic stage of bacillary dysentery, 328; use of, as lotion in pustular or ulcerative syphiloderms, 426.
Creosotal, use of, in pneumonia, 235.
Creosote, use of, in enlargement of the lymphatic glands complicating measles, 162; in pneumonia, 235; to relieve expectoration in pulmonary tuberculosis, 498; in whooping-cough, by inhalation, 181.
CROCKER, lotion recommended by, for itching in diabetes mellitus, 764.
Croton oil, use of, in nephritis complicating scarlet fever, 134.
CROUP, DIPHTHERITIC, administration of antitoxin in, 269, 270, 275.
CROUP, NON-DIPHTHERITIC, as a complication of measles, 157.
Croup kettle, use of, in the cough of tuberculosis, 497; in the laryngeal complications of diphtheria, 157.
CRYSTALLOSE, as substitute for sugar in diabetes mellitus, 759.
CUBA, history of vaccination in, 103.
Cups, dry, use of, in nephritis complicating scarlet fever, 133.
Cups, wet, use of, in pneumonia together with inhalations of oxygen, 237.
Curettage, use of, in laryngeal tuberculosis, 493.
CURRIE, use of hydrotherapy in general infections first advised by, 16.
CUSHING, DR. E. W., on water in diet of typhoid fever, 14.
CUSPIDORS, disinfection of, in tuberculosis, 453.
Cutaneous administration of mercury, 387.
CUTANEOUS DISORDERS, associated with intestinal autointoxication, 682.
CYCLASTIS SCARLATINALIS, 115.
CYNANCHE PAROTIDÆA. *See* Mumps.
Cyprus oil, use of, in whooping-cough, 181.
CYTORYCTES VARIOLÆ, 41.
DANA, condition called "wet brain" first described by, 608.

- DARNEL, THE**, poisoning by, 651.
- DAVIS, D. J.**, investigation by, of organisms in acute rheumatism, 293.
- DEAD**, disposal of, in small-pox, 45.
- DEARDEN**, on constitutional effects of phosphorus poisoning, 629.
- DEFORMITIES**, accompanying rachitis, 818.
- "DELAYED RESOLUTION,"** treatment of, in pneumonia, 257.
- DELIRIUM TREMENS**, 601; alcohol in, 607; diet in, 603; drugs in, 604; hypnotics in, 605; mortality from, 607; treatment of, at beginning of attack, 602; treatment of, at height of attack, 603; "wet brain" in, 608.
- Demulcent drinks**, use of, in barbel cholera, 644.
- Demulcent substances**, use of, to relieve cough in tuberculosis, 496.
- DENMARK**, antituberculosis work in, 442; introduction of vaccination into, 60.
- Denys bouillon filtrate**, 512; use of, in tuberculosis, 513.
- DERMATOMYOSITIS**. *See* Polymyositis, acute.
- DETWEILER**, rest in treatment of tuberculosis advocated by, 477.
- Dextrose**, subcutaneous injection of, in diabetic coma, 758.
- DIABETES INSIPIDUS**, 774; causes of, 774; definition of, 774; diet in, 776; drugs in treatment of, 777; organic extracts in treatment of, 778; treatment of, 775.
- DIABETES MELLITUS**, 717; acidosis in, 731; anesthesia dangerous in, 769; boils as symptom of, 765; brachial neuritis, as a symptom of, 766; caloric needs of the body in, 737; in children, 768; coma in, 731; diabetophobia and, 768; diet lists for use in, 738; dietetic regimen in, 750; drugs in treatment of, 759; energy requirements in, 724; exercise in, 763; eye affections accompanying, 766; foods allowable in, 738, 751; foods allowable in, under restriction, 739, 751; foods forbidden in, 751; frequency of, 718; gangrene accompanying, 770; general principles in treatment of, 734; glycosuria in, 719; grades of severity in, 735, 758; "green days" in treatment of, 756; health resorts in treatment of, 762; heredity in causation of, 719; history of, 717; hydrotherapy for relief of, 762; hyperglycemia in, 722; impotence accompanying, 766; itching as a symptom of, 764; Jewish race specially liable to, 719; marriage undesirable in, 769; mortality from, 718; neuralgia as a symptom of, 766; neuritis as a symptom of, 766; oatmeal treatment for, 753; operative measures for cure of, 770; opotherapy for, 760; organic extracts in treatment of, 760; overfeeding in causation of, 719; pathogenesis of, 719; physical examinations in, 736; in pregnancy, 768; prognosis of, 729; prognosis of diabetic coma in, 757; prophylaxis against, 730; prostatic disease as a symptom of, 766; sciatic pain accompanying, 766; sources of sugar in the body, 725; spa treatment of, 763; substitutes for sugar in diet of, 749; substitutes for vegetable starch in diet of, 718; sugars present in urine of, beside glucose, 727; summary of dietetic treatment of, 758; surgical operations in, 769; syphilis associated with, 768; temperature of atmosphere an influence on body in, 764; tests for acetone bodies in, 732; thyroid gland and its influence upon, 767; transient glycosuria in, 726; treatment of, 734; treatment of acidosis in, 756; treatment of coma accompanying, 757; treatment of special symptoms in, 764; tuberculosis associated with, 767; vulvitis accompanying, 765; xanthoma diabeticorum as a symptom of, 765.
- DIABETIC ACIDOSIS**, 731; treatment of, 756.
- DIABETIC COMA**, 731; prognosis of, 758; treatment of, 757.
- DIABETIC EYE AFFECTIONS**, 766.
- DIABETIC GANGRENE**, 770.
- DIABETIC NEURALGIA**, 766.
- DIABETIC NEURITIS**, 766.
- DIABETIC PRURITUS**, 765.
- DIABETIC VULVITIS**, 765.
- DIABETICS, PNEUMONIA OF**, 258.
- DIABETOPHOBIA**, 768.
- DIACETIC ACID**, test for, 732.
- DIARRHEA**, accompanying tuberculosis, 505; concentrated diet for, 556; treatment of, in pellagra, 662.
- DIARRHEA, INFANTILE**, treatment of, 328.
- Digalen**, use of, in pneumonia with cardiac depression, 251.
- DIGESTION, ABNORMAL PRODUCTS OF**, intestinal autoinfection due to, 666.

- DIGESTION, NORMAL PRODUCTS OF**, intestinal autointoxication not due to, 666.
- DIGESTIVE JUICES AND SECRETIONS**, not concerned in intestinal autointoxication, 666.
- Digitalin**, use of, in delirium tremens, 604.
- Digitalis**, use of, in bronchopneumonia complicating influenza, 192; in cardiac failure complicating influenza, 193; in cardiac toxemias of pneumonia, 249; as cardiac stimulant in Rocky Mountain fever, 565, 566; in cerebrospinal meningitis, 214; in delirium tremens, 604; in diphtheria, 277; in erysipelas, 284; in nephritis complicating scarlet fever, 134; resinoids of, unsuitable in pneumonia, 251; in scarlet fever with cardiac weakness, 127; in septicemia, 291; in typhoid fever, 23.
- DILATATION OF THE STOMACH**, ACUTE, as a complication of pneumonia, 259.
- Dionin**, substitution of, for morphin in treatment of morphinism, 418.
- DIPHTHERIA**, 266; adenitis complicating, 277; alcohol in, 276; anaphylaxis following injection of antitoxin in, 271; antitoxin treatment of, 269; bacteriology of, 266; bronchopneumonia, complicating, 278; classification of, 268; complications of, 276; definition of, 266; diet in, 275; dose of antitoxin in, 269; feeding after intubation in, 276; immunization against, 268; indications for antitoxin in, 269; intubation in, 272; irrigation of ear in otitis media complicating, 278; irrigation of nasopharynx in, 271; kidney complications in, 279; larynx affected in, 272; local treatment in, 271; location of membrane in, 269; medicinal treatment of, 275; mental apathy in, 270; mode of injecting antitoxin in, 270; nursing in, 275; operative measures for cervical adenitis complicating, 277; otitis media complicating, 277; physician's duty as regards infection in, 267; post-diphtheritic paralysis following, 278; pretracheal abscess complicating, 279; prophylaxis in, 266; quarantine in, 267; site for injection of antitoxin in, 270; skin affections complicating, 279; use of sprays in, 272; use of stimulants in, 277; tracheotomy in, 279; treatment of, in general, 238.
- Diphtheria antitoxin**. *See* Antitoxin.
- DIPHTHERIA BACILLUS**, toxalbumins obtained from, 635.
- DIPHTHERITIC CROUP**. *See* Croup.
- Diphtheritic serum**, injection of, for control of hemorrhage in hemorrhagic form of measles, 155.
- DIPSOMANIA**, 591; association of, with intestinal autoinfection, 683; treatment of, 601.
- DISEASE**, certain forms of, a predisposing cause of alcoholism, 590.
- Disinfectants**, for use in tuberculosis, 452.
- DISTRICT OF COLUMBIA**, antituberculosis work in, 444.
- Diuretics**, use of, in scarlet fever, 125; in nephritis complicating scarlet fever, 132, 133.
- Diuretin**, use of, in nephritis complicating scarlet fever, 134.
- Dobell's solution**, use of, in diphtheria, 272; in laryngeal tuberculosis, 493; as mouth wash in mumps, 170; to relieve "colds" accompanying tuberculosis, 508; in typhoid fever, 11.
- DOBSON AND POOLE**, sugar first isolated from diabetic urine by, 717.
- DOHI**, case reported by, showing local effect of mercury on syphilitic lesions, 421.
- Donovan's solution**, use of, in pellagra, 661.
- Douche**, use of, in respiratory type of influenza, 189.
- Douche, cold**, use of, in after-treatment of morphinism, 624.
- Douche, hot**, use of, in the hemorrhagic form of measles, 154.
- Douche, vaginal**, use of, in diabetic vulvitis, 765.
- Dover's powder**, use of, to relieve "colds" in tuberculosis, 508.
- DREYER**, potassium permanganate treatment of small-pox advocated by, 51.
- Drinking water**. *See* Water.
- DRUG ERUPTIONS**, diagnosis between, and vaccination, 92.
- Drugs**, misuse of, in whooping-cough, 175; prevention of scarlet fever by use of, 123.
- Dry cups**. *See* Cups.
- Dry heat**. *See* Heat.
- "DRY KNEE JOINT,"** 709.
- "DRY TAP,"** 203.
- DUKE'S DISEASE**, 165.

- DULCIN**, as substitute for sugar in diabetes mellitus, 749.
- DUST**, transmission of measles by, 147; transmission of small-pox by, 42, 43.
- DUSTING POWDERS**, use of, in connection with counterirritation for relief of bronchopneumonia complicating measles, 159; in treatment of nasal and pharyngeal complications of measles, 156; in treatment of small-pox, 48, 49; in treatment of varicella, 112.
- DUVAL AND BASSETT**, determination by, of special causal agent in infantile summer diarrhea, 316.
- DYSENTERY, ACUTE BACILLARY**, 316; agglutination reaction in, 320; bacteriology of, 317; "carriers" of, 320; classification of, 316; definition of, 316; diet in acute cases of, 324; diet in chronic cases of, 328; discovery of bacillus causing, 316; drugs in, 326, 329; epidemiology of, 319; geography of, 319; infantile diarrhea, 328; introduction to subject, 316; operative measures indicated in, 328; organisms present in, 317; pathology of, 318; serum treatment of, 321; sources of infection in, 319; transmission of, 319; treatment of acute cases of, 324; treatment of chronic cases of, 327; treatment of, in general, 321; treatment other than specific in, 323; vaccine treatment of, 322.
- DYSPNEA**, accompanying tuberculosis, 506.
- EAR**, irrigation of, in otitis media complicating diphtheria, 278.
- EATING UTENSILS**, disinfection of, in tuberculosis, 466.
- ECLAMPSIA, INFANTILE**, relation of, to rickets, 819.
- ECZEMA**, as a complication of vaccination, 91.
- EDEMA, MALIGNANT**, epidemic of, apparently due to *B. proteus vulgaris* infecting sardines, 644.
- EDEMA OF THE GLOTTIS**, as a complication of mumps, 171; as a complication of small-pox, 51.
- EDEMA OF THE LARYNX**, as a complication of measles, 158.
- EDEMA OF THE LUNGS**, as a complication of pneumonia, 259; as a complication of Rocky Mountain fever, 565.
- EDSALL AND PEMBERTON**, report by, on X-ray treatment of delayed resolution in pneumonia, 258.
- EDUCATION OF NERVE CENTERS** after Korsakow's psychosis, 609.
- EDUCATION OF PUBLIC**, influence of, against alcoholism, 592; in prophylaxis of pneumonia, 223.
- EGGS**, poisoning by, 636; use of, in diabetes mellitus, 744.
- ELATERIUM**, use of, in nephritis complicating scarlet fever, 134.
- ELECTRIC LIGHT CABINET**, use of, for elimination of poisons in intestinal autointoxication, 672.
- ELECTRICITY**, use of, in arthritis associated with intestinal autointoxication, 681; in Korsakow's psychosis, 609; in mumps, 172; for ocular paralysis accompanying meat poisoning, 640; in paralysis following cerebrospinal meningitis, 214; for relief of neuralgic pain following the cure of morphinism, 624.
- ELECTROTHERAPY**, use of, in arthritis deformans and chronic rheumatism, 713; in diabetic neuralgia and neuritis, 766.
- ELECTROVARGOL**, use of, by subcutaneous or intravenous injection in typhus fever, 37.
- EMESIS**, use of, in cheese poisoning, 647; in meat poisoning due to *B. enteritidis*, 641; in meat poisoning due to *B. paratyphosus*, 642.
- EMMERICH AND WEIBEL**, epidemic among trout investigated by, 644.
- EMPYEMA**, accompanying tuberculosis, 507; as a complication of pneumonia, 261.
- ENDOCARDITIS**, accompanying septici-pyemia, 288; as a complication of pneumonia, 260.
- ENEMATA**, use of opium by, in bacillary dysentery, 327; in infantile diarrhea, 329.
- ENEMATA, GRADUATED**, use of, in intestinal autointoxication, 674.
- ENEMATA, HIGH RECTAL**, use of normal saline solution by, in cheese poisoning, 647; in diabetic coma, 757; in meat poisoning due to *B. paratyphosus*, 642.
- ENEMATA, HIGH RECTAL**, use of protargol by, in meat poisoning due to *B. enteritidis*, 641.
- ENEMATA, HIGH RECTAL**, use of soap and water by, for impaction of feces in intestinal autointoxication, 672.

- Enemata, high rectal**, use of turpentine by, in meat poisoning due to *B. botulinus*, 639.
- Enemata, nutrient**, use of, in delirium tremens, 602.
- Enemata, saline**, use of, by the drop method in Rocky Mountain fever, 566.
- Enemata, warm saline**, use of, to control hemorrhage in pulmonary tuberculosis, 502; to control hemorrhage in typhoid fever, 19; in influenza, of a gastro-intestinal type, 190; in nephritis complicating scarlet fever, 133; in septicopyemia, 290; in typhoid fever, 26.
- ENERGY, REQUIREMENTS IN DIABETES MELLITUS**, 724.
- ENGLAND**, antituberculosis work in, 440; mortality from small-pox in, before and after vaccination, 93.
- Enteroclysis**, employment of, in sepsis complicating scarlet fever, 128.
- ENTEROCOLITIS**, as a complication of measles, 160.
- ENTEROPTOSIS**, associated with autointoxication due to habitual constipation, 678.
- EPIDIDYMITIS**, as a complication of mumps, 166; treatment of, 171.
- EPILEPSY**, association of, with intestinal autointoxication, 682.
- EPISTAXIS**, as a complication of glandular fever, 576; as a complication of typhoid fever, 27.
- Epsom salts**. *See* Magnesium sulphate.
- Epstein diet**, for reduction of obesity, 791.
- Ergot**, use of, in cerebrospinal meningitis, 213; for control of hemorrhage in pulmonary tuberculosis, 509; in delirium tremens, 605; in diabetes insipidus, 777; in hematuria complicating scarlet fever, 134; in hemorrhagic form of measles, 156.
- ERGOTISM**, 652.
- Ergotol**, use of, for control of hemorrhage in the hemorrhagic form of measles, 156.
- ERUPTION**, in differential diagnosis between typhoid and typhus fever, 38; following use of antitoxin in diphtheria, 271; following use of arsenobenzol in syphilis, 415; treatment of, in small-pox, 48.
- ERUPTION, CHARACTER OF**, in cow-pox, 56; in hemorrhagic form of varicella, 113; in miliary fever, 578; in typhoid fever, 38; in typhus fever, 33; in varicella, 112.
- ERYSIPELAS**, 281; assistant causes in, 281; Bier's hyperemia treatment of, 285; characteristic lesion in, 282; complications of, 283; definition of, 281; diagnosis of, 283; diet in, 283; effect of, upon other diseases, 285; etiology of, 281; incision in treatment of, 285; local treatment of, 284; "medical" form of, 282; "migratory cases" of, 283; organism causing, 281; pathologic anatomy in, 282; pathology of, 282; predisposing causes of, 281; prognosis of, 283; sequelæ to, 283; serum therapy in, 284; small-pox complicated by, 49; symptoms of, 282; temperature in, 282, 283; treatment of, 283; treatment of complications in, 285; vaccination complicated by, 85; vaccine therapy for, 284.
- ERYTHEMA MULTIFORME**, as complication of vaccination, 85.
- Erythrol tetranitrate**, use of, to control hemorrhage in pulmonary tuberculosis, 500.
- Eserin**, use of, in diabetes mellitus, 760; for relief of corneal ulceration in small-pox, 50; in syphilitic iritis, 429.
- Esmarch bandage**, use of, to determine site of arterial obstruction in diabetic gangrene, 770.
- Ether**, use of, as cardiac stimulant in typhoid fever, 24.
- Ether**, use of, by spray, for relief of neuralgic pains following cure of morphinism, 624; for small-pox, 49.
- Ether, subcutaneous injections of**. *See* Injections.
- Ether inhalations**, in cerebrospinal meningitis, 214.
- ETHER PNEUMONIA**. *See* Pneumonia.
- Eucaïn**, in local treatment of tertiary syphilitic lesions of mucosæ and mucocutaneous junctions, 427; as mouth wash in stomatitis due to hydrargyrisim, 385.
- Eucalyptol**, in gangrene of the lung complicating pneumonia, 261; in prophylaxis of influenza, 186.
- Eucalyptus oil**, use of, in chronic influenza or bronchiectasis complicating influenza, 195; in scarlet fever, 124.
- Eucalyptus ointment**, use of, to relieve itching in Rocky Mountain fever, 565.
- Euquinin**, use of, in measles, 151.
- EXANTHEMA**, influence of vaccination on, 74.

- EXCRETA, DISINFECTION OF**, in small-pox, 44; in typhoid fever, 7.
- Exercise**, value of, in chronic gout, 700; in diabetes mellitus, 763; in intestinal autointoxication, 676; in obesity, 806; in tuberculosis, 477, 527.
- Exercises**, forms of, beneficial to intestinal autointoxication, 676.
- Expectorants**, use of, in chronic influenza or bronchiectasis complicating influenza, 195.
- EXPECTORATION**, in pulmonary tuberculosis, 498.
- EYES**, affections of, in diabetes mellitus, 766; care of, in small-pox, 50.
- FAMILY**, duty of, regarding scarlet fever, 121.
- Fan bath**, use of, in typhoid fever, 18.
- FAT**, proportion of, in human body, 779; relation of, to phosphorus poisoning, 627, 628.
- FAT EMBOLISM**, following intramuscular injection of mercury in syphilis, 401.
- FATS**, functions of, in body, 782; as a source of adipose tissue, 783; as a source of energy and heat, 782; sugar derived from, 726; use of, in diabetes, 743.
- Febrifuges**, use of, in scarlet fever, 125, 126.
- FECES**, method of disinfecting, in typhoid fever, 7.
- Feeding, artificial**, by gavage in meat poisoning, 639; method of, after intubation of larynx, 276; method of, in post-diphtheritic paralysis, 278; method of, in tetanus, 350; by nutrient enemata in delirium tremens, 602; by rectum, *See* Rectal feeding; by subcutaneous injection in tetanus, 350.
- FEEDING OF INFANTS, USE OF ARTIFICIAL FOODS IN**, precautions to be observed in, against tuberculosis, 457; a predisposing cause of rachitis, 815.
- FETTEROLF**, table prepared by, showing composition of commercial diabetic bread and flour, 746.
- Fibrolysin**, use of, in treatment of delayed resolution in pneumonia, 258.
- FINGER AND LANDSTEINER**, contagiousness of tertiary syphilitic lesion established by, 371.
- FISCH AND HILL**, isolation of influenza bacillus in pure culture reported by, 190.
- FISH**, poisoning by, 643.
- Fistulæ**, as a complication of tuberculosis, 509.
- "FLAT FOOT,"** 709.
- Flaxseed poultice**. *See* Poultice.
- FLEXNER, SIMON**, work done by, on the etiology of bacillary dysentery other than the epidemic form, 316; work of, on influenzal form of meningitis, 194, 210.
- FLEXNER AND SWEET**, work by, on differences between Shiga and Flexner bacilli, 317.
- FLEXNER STEM BACILLUS, THE**, 317.
- FLICK, DOCTOR LAWRENCE**, work done by, in the prevention of tuberculosis, 446.
- FLIES**, dysentery transmitted by, 319; small-pox transmitted by, 42; tuberculosis transmitted by, 455; typhoid fever transmitted by, 7.
- FLUIDS**, limitation of, in treatment of obesity, 805.
- Flushing of the bowel**. *See* Colonic flushing.
- FLY-AGARIC**, 648.
- Fly blisters**. *See* Blister.
- FOOD INFECTION**, a cause of food poisoning, 636.
- Food**, preparation of, in tuberculosis, 544.
- FOOD POISONING**, 631; animal organisms causing, 634; bacteria in causation of, 635; bacteriology involved in, 631, 634; changes in food-stuffs a cause of, 632; cheese poisoning, 647; ergotism, 652; excess in foodstuffs a cause of, 632; factors in digestive process and, 631; fish poisoning, 643; general considerations regarding, 631; infection of food a cause of, 636; intracellular fermentation a cause of, 636; lathyrism, 652; meat poisoning, 637; milk poisoning, 645; mushroom poisoning, 647; poisoning due to food of vegetable origin, 647; poisoning due to fungi, 652; poisonous roots, 650; poisonous fruits and seeds, 651; poisonous herbage, 651; ptomaines in causation of, 635; special forms of, 636; toxic substances produced in physical processes of digestion, 632; toxins in causation of, 635; vegetable organisms a cause of, 634.

- FOOD PRESERVATIVES**, digestibility of food lessened by, 634.
- FOOD REQUIREMENTS**, in health, 781; in tuberculosis, 539.
- FOOD-STUFFS**, contamination of, a cause of poisoning, 634; forms of, containing exogenous poisons, 633; idiosyncrasy toward, a cause of poisoning, 633; poisonous forms of, 633; systemic poisoning caused by, 632.
- FOOD SUPPLY**, sources of, in tuberculosis, 543.
- FOODS**, in causation of rachitis, 815; functions of, in body, 781; restriction of, in diabetes mellitus, 750; restriction of, in treatment of obesity, 800.
- FOODS OF VEGETABLE ORIGIN, POISONING BY**, 647; mushrooms, 647; poisoning by herbage, 651; poisonous fruits and seeds, 651; poisonous roots, 650.
- FOOT AND MOUTH DISEASE**, 581; definition of, 581; production of, by inoculation, 581; prophylaxis of, 581; quarantine for, 582; transmission of, 582; treatment of, 583.
- Forced feeding.** *See* Hyperalimentation.
- FORLANINI**, production of artificial pneumothorax in tuberculosis revived by, 535.
- Formaldehyd**, use of, in disinfection for influenza, 186.
- Formaldehyd gas**, as disinfectant in tuberculosis, 452.
- Formalin**, use of, for flushing the colon in intestinal autointoxication, 674; in local treatment of laryngeal tuberculosis, 493.
- Formula**, for use in chronic alcoholism, 595.
- FORNACA**, opinion of, on serum treatment of erysipelas, 284.
- Fowler's solution of arsenic**, use of, in pellagra, 661.
- FOUCAULT**, primary acute suppurative myositis first described by, 686.
- FRANCE**, antituberculosis work in, 442; history of vaccination in, 60.
- Freezing, anesthesia by**, use of, in excision of chancre, 378.
- Frehier's artificial phlegmon**, use of, in typhus fever, 37.
- FRIEDBURGER AND SACHS**, report by, of hydrophobia cured by combination of atoxyl and thioglycolic acid, 343.
- FRIMLEY**, scheme of graduated exercise in tuberculosis employed at, 529.
- FROEBEL**, possibilities of character building in play disclosed by, 593.
- FRUIT SUGAR.** *See* Levulose fructose.
- FUGIN**, fish poisoning due to, 643.
- FULLER**, early description of varicella by, 109.
- Fumigation**, as a means of administering mercury in syphilis, 389.
- FUNGI**, poisoning due to, 652.
- FUNGUS-ATROPIN**, 648.
- FURUNCULOSIS**, as a complication of typhoid fever, 29; as a complication of vaccination, 86.
- Galactotoxismus.** *See* Milk poisoning.
- GALL-BLADDER AFFECTIONS**, as complications of typhoid fever, 28.
- GANGRENE**, diabetic, *see* Diabetic gangrene; of the lung, as a complication of pneumonia, 261; of the pock, as a complication of vaccination, 87; of skin, as a complication of varicella, 113.
- Gargles**, use of, in measles, 148; use of, in scarlet fever, 125.
- GARROD'S THREAD TEST**, for uric acid in gout, 695.
- GASTRIC IRRITABILITY**, in typhoid fever, 25.
- Gastric lavage.** *See* Lavage.
- GASTROINTESTINAL DISORDERS**, as a complication of scarlet fever, 132; as a complication of tuberculosis, 502; due to hydrargyritism, 384.
- GASTROINTESTINAL TYPE OF INFLUENZA.** *See* Influenza.
- Gavage**, employment of, in after-treatment of diphtheria, 276; in cerebrospinal meningitis, 212; in meat poisoning, 639; in post-diphtheritic paralysis, 278.
- Gelatin**, use of, for control of hemorrhage, in the hemorrhagic form of measles, 155, 156; in pulmonary tuberculosis, 501.
- Gelsemium**, use of, in tetanus, 348.
- GENEVA**, mortality from small-pox in, before and after vaccination, 95.
- GENITAL ORGANS, DISORDERS OF**, as a complication of measles, 161.
- GENITALIA**, care of, in varicella, 113.
- Gentian**, use of, as a tonic in tuberculosis, 504.
- GERHARDT'S TEST**, for diacetic acid in the urine, 732.
- GERMAN ARMY**, effects of vaccination and revaccination in, 101.

- GERMAN MEASLES, 164; treatment of, 165.
- GERMAN VACCINATION LAW, results of, 100.
- GERMANY, antituberculosis work in, 441; introduction of vaccination into, 60; mortality from small-pox in, before and after introduction of vaccination, 93; passage of vaccination law in, 60; results of vaccination law in, 100.
- Gioson's rule, for use in blood pressure study during treatment of pneumonia with cardiac toxemia, 255.
- GLANDERS, 357; artificial immunity against, 357; immunity conferred by one attack of, 357; occurrence of, 357; precautions against infection from discharges in, 358; serum treatment of, 358; specific treatment of, 358; transmission of, 357; vaccine treatment of, 358.
- GLANDULAR ENLARGEMENT, accompanying rachitis, 818.
- GLANDULAR FEVER, 574; adenitis accompanying, 576; characteristics of, 574; complications of, 577; convalescence from, 577; definition of, 574; non-contagiousness of, 575; prognosis in, 577; prophylaxis against, 575; treatment of, 576.
- GLISSON, early contributions by, to knowledge of rachitis, 812.
- Globularin, use of, in diabetes insipidus, 777.
- GLOTTIS, EDEMA OF. *See* Edema.
- GLUCOSE, presence of, in diabetic urine, 727, 728; as substitute for sugar in diet of diabetics, 754.
- Glycerin, use of, as diluent for small-pox vaccine virus, 65, 66; as gargle in measles, 148; to prevent acidosis in diabetes mellitus, 757; by rectum in diabetic coma, 757; by rectum for relief of meteorism in typhoid fever, 26.
- GLYCOHEPTONIC ACID, as substitute for sugar in diabetes mellitus, 750.
- GLYCOSURIA, alimentary, 726; presence of, in diabetes mellitus, 722; presence of, in gout, 696; transient, 726.
- Glycuric acid, use of, to prevent acidosis in diabetes mellitus, 757.
- GLYCURONIC ACID, presence of, in diabetic urine, 729.
- GOLDBERGER AND ANDERSON, investigations by, on transmission of typhus, 33.
- Golden sulphuret of antimony, use of, as an expectorant in pneumonia, 257.
- GOLDTHWAITE, on static pains, 709.
- GONORRHEAL ARTHRITIS. *See* Arthritis, gonococcic.
- GOUT, 692; acute form of, 696; age in causation of, 694; alcohol injurious in, 798; areas of prevalence of, 694; cardiovascular lesions of, 695; chronic form of, 696; clinical features of, 692; definition of, 692; dietetic management of, 699; drugs in treatment of acute gout, 702; drugs in treatment of chronic gout, 703; etiology of, 693; exercise in treatment of, 700; glycosuria, associated with, 696; gouty kidney in, 695; health resorts in treatment of, 701; hydrotherapy for, 701; inheritance in causation of, 694; irregular forms of, 697; lead poisoning in causation of, 694; occupation in causation of, 694; onset of, 695; poor man's gout, 698; prophylactic treatment of, 697; retrocedent gout, 696; symptoms of, 695; tobacco smoking in causation of, 698; treatment of acute attack of, 701.
- GOVERNMENTS, duty of, concerning precautions in manufacture of matches, 630.
- "GREEN DAYS," in treatment of diabetes mellitus, 756.
- Guaicol, local application of, in mumps, 170, 171; use of, in pneumonia, 236.
- Guaicol carbonate, use of, in arthritis deformans and chronic rheumatism, 714; use of, by inunction in scarlet fever, 126.
- GUANIERI, description of small-pox organism by, 41.
- GUERICH, removal of tonsils during attack of acute rheumatism advised by, 294.
- GUMMA, local treatment of, 430.
- GUTTSTADT, on results of vaccination upon mortality from small-pox in Berlin, 99.
- HABITS OF LIFE, association of, with intestinal autointoxication, 675.
- HALL, DR. J. K., death from hemorrhage complicating pellagra reported by, 662.
- HALLUCINOSIS OF DRUNKARDS, 608.
- HANNA, studies by, on vaccination done subsequently to infection with small-pox, 78.
- HANSEN, studies by, on transmission of leprosy by vaccination, 90.
- HARE, FRANCIS, on apomorphin in treatment of dipsomania, 601; on cause of delirium tremens, 602; on copper sul-

- phate in treatment of acute phosphorus poisoning, 627; on sodium bromid in treatment of morphinism, 620; on treatment of alcoholism with atropin and strychnin, 596; on withdrawal of alcohol altogether in delirium tremens, 607.
- Harvey-Banting cure for obesity**, 790.
- HEADACHE**, associated with intestinal auto-intoxication, 681; in typhoid fever, 27.
- Health resorts**, benefit of, in treatment of chronic gout, 701; in treatment of diabetes mellitus, 762; in treatment of obesity, 789, 809.
- HEART**, diseases of, as a complication of measles, 161; precautions concerning, in pneumonia, 225.
- Heat, dry**, use of, in gangrenous chancre, 423; in typhoid fever, as cardiac stimulant, 24.
- HEAT LOSS**, in relation to treatment for obesity, 784.
- HEBERDEN**, early description of varicella by, 109.
- HEBERDEN'S NODOSITIES**, as characteristic feature of hypertrophic arthritis, 708; presence of, in chronic gout, 696.
- HEBRA AND KAPOSI**, use of soluble salt method in treatment of syphilis introduced by, 390.
- HEMATURIA**, as a complication of scarlet fever, 134.
- Hemoptysis**, in influenza with complications, 195.
- HEMORRHAGE**, as a complication of pellagra, 662; as a complication of typhoid fever, 19; as a complication of whooping-cough, 175; into the pock, as a complication of vaccination, 87; in pulmonary tuberculosis, 499; relation of, to exercise, 529; treatment of, 500.
- "HENDON COW DISEASE,"** 114.
- HERBAGE**, poisoning by, 651.
- HEREDITY**, in causation of alcoholism, 590; in causation of gout, 694; in causation of rachitis, 815.
- Heroin**, use of, in bronchitis complicating influenza, 189; contraindicated in chronic influenza, 195; to control cough in active stage of pulmonary tuberculosis, 482; to control cough in laryngeal tuberculosis, 498; substitution of, for morphin in treatment of morphinism, 618; in whooping-cough, 182.
- Heroin and terpin hydrate, elixir of**, in cough of tuberculosis, 498.
- HERZFELD**, on preventive treatment of migraine in gastrointestinal auto-intoxication, 682.
- HEWES**, rectal injections of silver nitrate advised by, in bacillary dysentery, 327; dietary advised by, 325.
- Hewes dietary**, for use in bacillary dysentery, 325.
- Hexamethylamin**. *See* Urotropin.
- HICCOUGH**, as a complication of pneumonia, 260.
- Hirschfeld's diet**, for reduction of obesity, 794.
- HIRSCHLAFF**, morphia heil-serum introduced by, for treatment of morphinism, 624.
- HIRT**, hypnotism and mental suggestion employed by, in treatment of morphinism, 624.
- HOFFMAN, MR. FREDERICK L.**, statistics concerning decrease in death rate from tuberculosis furnished by, 450.
- Hoffman's anodyne**. *See* Compound spirits of ether.
- HOLLAND**, introduction of vaccination into, 60.
- HORSECHESNUT**, poisoning by, 651.
- HORSE-POX**, 55.
- Horse serum**, injection of, for control of hemorrhage in hemorrhagic measles, 155.
- HOSPITALS**, prevention of measles in, 144; prevention of scarlet fever in, 121.
- Hot water bags**, use of, in bacillary dysentery, 324.
- HOUSE INFECTION**, in tuberculosis, 451.
- HOWE**, cases reported by, of pemphigus following vaccination, 91.
- Hunter's treatment of erysipelas**, 285.
- HUGHES**, beneficial effects of potassium nitrate in pneumonia reported by, 228.
- HUTCHINSON**, chancres developing on vaccinations reported by, 89.
- Hydrargyri chloridum mite**. *See* Calomel.
- HYDRARGYRISM**, 383; buccal accidents due to, 384; cutaneous accidents due to, 384; gastrointestinal accidents due to, 384; general intoxication due to, 383; idiosyncrasy as a cause of, 383; mercurial stomatitis due to, 384; prevention of, 385; renal accidents due to, 384; salivation due to, 384; treatment of, 385.

- Hydriodic acid, syrup of**, use of, in glandular enlargement accompanying rachitis, 818.
- Hydrogen dioxid.** *See* Hydrogen peroxid.
- Hydrogen peroxid**, use of, contraindicated in washing out abscess cavity in diphtheria, 277; in gangrenous chancre, 423; as gargle in hydrargyrisms, 385; as gargle in syphilitic angina, 426; in inflamed chancre, 422; as mouth wash in mumps, 170; in syphilitic onychia, 429; in tertiary lesions of mucous or mucocutaneous surfaces, 427; in throat affections complicating scarlet fever, 129, 130.
- HYDROPHOBIA**, 334; cauterization of wound made by rabid animal, 336; complications of Pasteur treatment in, 340; constitutional effects of inoculation in, 339; constitutional measures of treatment for, 336; experiments by New York Health Department in cauterization of wounds made by rabid animals, 336; indications for antirabic treatment in, 334; local effects of inoculation in, 339; mortality from, affected by Pasteur treatment, 342; Pasteur treatment for, 334, 337; Pasteur treatment for, by mail, 341; precautions against infection of attendants upon, 343; prophylaxis in, 335; treatment of the developed disease, 342.
- Hydrotherapy**, use of, in after-treatment of morphinism, 624; in alcoholism, 594; in arthritis deformans and chronic rheumatism, 712; in bacillary dysentery, 324; in chronic gout, 701; in convalescence from influenza, 196; in delirium tremens, 606; in diabetes mellitus, 762; in the exaggerated form of measles, 149; in hallucinosis of drunkards, 609; in the Keeley gold cure of alcoholism, 600; in miliary fever, 580; in pellagra, 662; in pneumonia, 231; in reduction of obesity, 808; in Rocky Mountain fever, 565; in scarlet fever, 125, 127; in syphilis, 365, 435; in typhoid fever, 16.
- Hygienic measures**, in care of mouth, 368; in cure of morphinism, 624; in German measles, 165; in measles, 145; in prophylaxis of acute rheumatism, 296; in scarlet fever, 123; in syphilis, 368; in treatment of alcoholism, 599; in treatment of arthritis deformans, 711; in treatment of hereditary syphilis, 432; in whooping-cough, 177.
- Hygienic-dietetic treatment**, of tuberculosis, 477.
- Hyoscin**, use of, in delirium tremens, 606; in delirium of pneumonia, 228; in pneumonia of alcoholics, 258; in treatment of morphinism, 620.
- Hyoscin hydrobromate**, use of, for relief of delirium in septicemia, 291; for relief of insomnia in typhoid fever, 27.
- Hyoscyamus**, use of, in after-treatment of morphinism, 624.
- Hyperalimentation**, in tuberculosis, 478, 538.
- HYPERGLYCEMIA IN DIABETES MELLITUS**, explanation of, 722.
- HYPERPYREXIA**, in acute rheumatism, 302.
- Hypnotic suggestion**, use of, in treatment of alcoholism, 600; in treatment of morphinism, 624.
- Hypnotism**, use of, in chronic alcoholism, 597; in delirium tremens, 605; in hallucinosis of drunkards, 609; in treatment of morphinism, 624.
- Hypodermic injections.** *See* Injection, subcutaneous.
- Hypodermoclysis**, of normal saline solution, for collapse in acute stage of bacillary dysentery, 327; for hemorrhage in pulmonary tuberculosis, 502; for infantile diarrhea, 329.
- Hypodermoclysis**, use of, in bilious pneumonia, 258; in sepsis complicating scarlet fever, 128.
- Hypophosphites**, use of, in convalescence from pneumonia, 262.
- Ice**, transmission of typhoid fever by, 3.
- Ice**, use of, in parotitis complicating typhoid fever, 27.
- Ice bag**, use of, in adenitis complicating glandular fever, 576; in cerebrospinal meningitis, 213; in cervical adenitis complicating scarlet fever, 131; to control hemorrhage in pulmonary tuberculosis, 500; to control hemorrhage in typhoid fever, 20; in hemorrhagic form of measles, 154; in laryngeal complications of measles, 157; in measles, 150; in mumps, 170; as a preventive of myocarditis, 276; to reduce temperature in pneumonia, 231, 232; for relief of delirium in septicemia, 291; for relief of pain in acute

- rheumatism, 302; for relief of pain in pneumonia, 227; for relief of pain in small-pox, 47; as a stimulant in septicemia, 290; in throat affections complicating scarlet fever, 130.
- Ice cap**, use of, in bacillary dysentery, 324; in pneumonia, 226; for relief of headache in typhoid fever, 27; in scarlet fever, 127.
- Ice collar**, use of, in cervical adenitis complicating diphtheria, 277.
- Ichthyol**, use of, in cervical adenitis complicating scarlet fever, 131; in erysipelas, 284; to relieve itching in varicella, 112; in small-pox, 49.
- Ichthyol ointment**, use of, in acute gout, 702; in adenitis accompanying glandular fever, 576.
- ICHTHYOTOXISMUS**. *See* Fish poisoning.
- IDIOSYNCRASY**, as cause of disagreeable effects following injection of mercury, 392, 403; as cause of hydrargyrisms, 383.
- IMMERMANN**, tables by, showing yearly average of deaths from small-pox before vaccination, 100.
- Immobilization**, during acute stage of tuberculosis, 482.
- Immobilization of joints**, in arthritis deformans and chronic rheumatism, 712.
- Immune sera**. *See* Sera.
- IMMUNITY**, production of, by cow-pox, 57; by glanders, 357; by measles, 140; by mumps, 169; by tuberculin, 511; by vaccination, 77; by varicella, 110.
- IMMUNIZATION**, against anthrax, 131; combined method of, 331; method of, in diphtheria, 268; technique of, 332.
- IMPETIGO CONTAGIOSA**, as complication of vaccination, 86.
- IMPOTENCE**, as a symptom of diabetes mellitus, 766.
- "INCLUSION BODIES,"** presence of, in blood during scarlet fever, 115.
- Indian hemp**. *See* Cannabis indica.
- INDIANS**, tuberculosis among, 444.
- INDIVIDUAL PROPHYLAXIS AGAINST TUBERCULOSIS**, 455; marriage a factor in, 464; occupation a factor in, 463; precautions to be observed in presence of tuberculosis, 465; protection of children, 458; protection of infants, 457; protection of youth, 462; rules for school-children in, 460; rules for tuberculous subjects in, 466.
- INEBRIATES' REFORM ASSOCIATION**, 599.
- INFANT**, protection of, against tuberculosis, 456.
- INFECTIOUS DISEASES**, as complications of measles, 161; liability to, of children with whooping-cough, 175; transmission of, by diseased meat, 637.
- INFLUENZA, ACUTE**, 184; bacteriology of, 184; bronchiectasis complicating, 194; bronchitis complicating, 189; cardiocirculatory complications of, 193; chronic influenza complicating, 194; classification of, 188; complications of, 191; convalescence from, 196; diet in, 188; gastrointestinal type of, 189; general treatment of, 187; immunity conferred by, 186; joint affections complicating, 194; meningitis complicating, 193; mortality from bronchopneumonia as a complication of, 192; nephritis complicating, 194; nervous type of, 190; pneumonia complicating, 191; prophylaxis in, 185; rare complications of, 194; respiratory type of, 188; serum treatment of, 186; sources of, 185; specific treatment of, 186; summary of subject, 196; symptoms of, 187; temperature in, 188; treatment of, 186; treatment of types of, 188; types of, 188.
- INFLUENZA, CHRONIC**, as a complication of the acute form, 194; treatment of, 195.
- INFLUENZAL MENINGITIS**, 193, 210.
- Inhalation**, use of drugs by, in whooping-cough, 180.
- Inhalation of alkalies**, for relief of laryngeal complications of measles, 157.
- Inhalation of steam**, for relief of expectoration in tuberculosis, 498.
- Inhalations**, use of, in laryngeal tuberculosis, 492; for relief of bronchitis accompanying tuberculosis, 508; for relief of cough in pulmonary tuberculosis, 497; for relief of inflammation of larynx in small-pox, 51; for relief of laryngotracheal cough in measles, 153; in the respiratory type of influenza, 189; solutions to be used in, 497.
- Injection**, administration of alcohol by, in diabetic neuritis or neuralgia, 766.
- Injection**, administration of mercury by, in syphilis, 390; by insoluble method, 394; by soluble method, 392.
- Injection, hypodermic**. *See* Injection, subcutaneous.

- Injection, intracerebral**, of tetanus antitoxin, 345.
- Injection, intralaryngeal**, use of, in laryngeal tuberculosis, 492, 493; solution for use by, 494.
- Injection, intramuscular**, of arsenobenzol in syphilis, 416; importance of, seen in septicopyemia, 289; of insoluble salts of mercury, 394; objections to use of mercury by, in hereditary syphilis, 433; objections to use of mercury by, in pregnancy, 432; of soluble salts of mercury, 392; of tetanus antitoxin, 345, 346.
- Injection, intravenous**, of adrenalin chlorid in pneumonia with cardiac toxemia, 252; of antianthrax serum, 332; of arsenobenzol in syphilis, 415; of electrovargol in typhus fever, 37; importance of, seen in septicopyemia, 289; of normal salt solution in bronchopneumonia complicating influenza, 192; of normal salt solution in meat poisoning, 639; of normal salt solution in sepsis complicating scarlet fever, 128; of normal salt solution in typhoid fever, 19; of sodium bicarbonate in diabetic coma, 757; of strophanthus in pneumonia with cardiac toxemia, 253; of tetanus antitoxin, 345.
- Injection, rectal**, use of, in enterocolitis complicating measles, 161; of normal salt solution in delirium tremens, 602; of normal salt solution in hemorrhage during pulmonary tuberculosis, 502; of normal salt solution in mumps, 171; of sodium bicarbonate in diabetic coma, 757.
- Injection, subcutaneous**, of alcohol, in cardiac failure complicating influenza, 193; of antianthrax serum, 332; of camphor in cardiac failure complicating influenza, 193; of camphor in pneumonia, with cardiac toxemia, 253; of collargolum in typhus fever, 37; of dextrose in diabetic coma, 758; of electrovargol in typhus fever, 37; of ether in cardiac failure complicating influenza, 193; of food, in treatment of tetanus, 350; of levulose in diabetic coma, 758; of normal salt solution in bronchopneumonia complicating influenza, 192; of normal salt solution in meat poisoning, 639; of normal salt solution in mumps, 171; of normal salt solution in poisoning by *amanita phalloides*, 649; of normal salt solution in typhoid fever, 19; of oxygen in pneumonia, 237; of tetanus antitoxin, 345; of tuberculin, 517.
- Injection, tracheal**, solution for use by, 494; use of, in laryngeal tuberculosis, 492, 493.
- Injections**, use of, in nasal and pharyngeal complications of measles, 156.
- Inoculation**, for rabies, *see* Pasteur treatment; for scarlet fever, 123; for smallpox, 52.
- Inosite**, use of, to prevent acidosis in diabetes mellitus, 757.
- INSECTS**, transmission of tuberculosis by, 455.
- INSOMNIA**, treatment of, in acute rheumatism, 302; in after-cure of morphinism, 624; in delirium tremens, 605, 607; in nervous type of influenza, 191; in Pasteur treatment for rabies, 339; in tuberculosis, 506; in typhoid fever, 26.
- Installations**, use of, in nasal and pharyngeal complications of measles, 156.
- Intermittent treatment**, administration of mercury by, in syphilis, 417.
- Intestinal antiseptics**. *See* Antiseptics.
- INTESTINAL AUTOINTOXICATION**, 664; alcoholism associated with, 683; anemias associated with, 680; causes of, 665; circulatory disorders associated with, 679; cutaneous disorders associated with, 682; definition of term, 664; diet in treatment of, 668, 677, 683; dipsomania associated with, 683; elimination in treatment of, 671; exercise in treatment of, 676; habits of life in causation of, 675; habitual constipation associated with, 677; intestinal antiseptics in treatment of, 674; liver disorders associated with, 679; metabolic disorders associated with, 680; nervous disorders associated with, 681; ocular affections associated with, 682; respiratory disorders associated with, 681; treatment of, 668; treatment of conditions and symptoms associated with, 675.
- INTESTINAL PARASITES**, poisoning due to presence of, in food, 634.
- INTESTINES**, disorders of, complicating measles, 160; disorders of, due to rachitis, 818; perforation of, in typhoid fever, 22; puncture of, for relief of meteorism in typhoid fever, 26.

- INTOXICATION**, alcoholic, *see* Alcoholism; chronic morphin, *see* Morphin addiction; general, following intramuscular injection of mercury for syphilis, 403; intestinal, definition of the term, 664.
- INTRACELLULAR FERMENTS**, decomposition produced by, in animal tissues and the effects of, 636.
- Intramuscular injection.** *See* Injection.
- Intravenous injection.** *See* Injection.
- Intubation of larynx**, indications for, in diphtheria, 274; indications for, in laryngeal complications of measles, 158; indications for, in laryngeal tuberculosis, 494; indications for, in laryngismus stridulus complicating rachitis, 820; method of performing, 274; reinsertion of tube, 275; removal of tube, 274.
- INULIN**, as substitute for vegetable starch in diabetes mellitus, 748.
- Inunction**, employment of, in scarlet fever, 124; as a means of administering mercury in syphilis, 387.
- Iodid of ammonium.** *See* Ammonium iodid.
- Iodid of calcium.** *See* Calcium iodid.
- Iodid of iron**, use of, in glandular enlargement accompanying rachitis, 818; in mumps, 170.
- Iodid of potash.** *See* Potassium iodid.
- Iodid of potash ointment**, use of, in mumps, 170.
- Iodid of rubidium.** *See* Rubidium iodid.
- Iodid of sodium.** *See* Sodium iodid.
- Iodids, organic**, use of, in syphilis, 410.
- Iodids**, use of, combined with colchicum, in acute gout, 703; in delayed resolution of pneumonia, 258; in diabetes insipidus with syphilitic taint, 777; in hereditary syphilis, 434; in syphilitic arthritis, 306.
- Iodin**, external use of, in abscesses complicating tuberculosis, 509; in cervical adenitis complicating scarlet fever, 131; in laryngeal complications of tuberculosis, 493, 494; in mouth disturbances accompanying diabetes mellitus, 736; in pharyngeal cough, 495; to relieve pain in the chest accompanying tuberculosis, 506; in small-pox, 48; in stomatitis due to hydrargyrisim, 385; over trachea and bronchi for relief of cough in tuberculosis, 497.
- Iodin**, external use of, in syphilis, in gummata, 430; in mucous patches, 427; in papular and tubercular tertiary lesions of syphilis, 426.
- Iodin**, internal use of, for enlargement of lymphatic glands complicating measles, 162; for nephritis complicating scarlet fever, 133; for reduction of obesity, 308.
- Iodin**, internal use of, in syphilis, 404; absorption of, 405; action of, 404; administration of, by mouth, 407; dosage of different preparations of, 408; dose of, in general, 406; elimination of, 405; hypodermic administration of, 408; ill effects of, 406; preparations of, 407; prophylaxis against iodism in, 406; proprietary preparations of, unreliable, 407, 409; rectal administration of, 408; in syphilitic bone lesions, 430; in syphilitic joint lesions, 430; treatment of iodism, 406; value of, 404.
- Iodin-vasogen**, use of, in local treatment of gummata, 430.
- Iodipin**, use of, in syphilis, 410.
- IODISM**, 406.
- Iodoform**, use of, as dusting powder for gangrenous chancre, 423; as dusting powder for mucous patches on genitalia, 427; in local treatment of laryngeal tuberculosis, 493; in suppositories for rectal chancre, 424.
- Ipecac**, use of, in bacillary dysentery, 326; to induce vomiting in acute alcoholism, 589.
- IRELAND**, antituberculosis work in, 441.
- IRITIS, SYPHILITIC**, local treatment of, 429.
- Iron**, use of, in after-treatment for chronic opium poisoning, 620; for anemia in tuberculosis, 507; in convalescence from diphtheria, 275; in convalescence from glandular fever, 577; in convalescence from influenza, 2; in convalescence from pneumonia, 262; in post-diphtheritic paralysis, 278; in rachitis, 818.
- Iron, tincture of chlorid of**, use of, in pneumonia, 234; in scarlet fever, 125; in throat affections complicating scarlet fever, 130.
- Iron, iodid of.** *See* Iodid of iron.
- Irrigation of colon.** *See* Colonic flushing.
- Irrigation of intestines in bacillary dysentery**, with nitrate of silver solution, 327; with normal saline solution, 327; with other drugs, 327, 328.

- Irrigation of nasopharynx**, in treatment of diphtheria, 272; otitis media caused by, 277.
- Irrigation of the tissues**, value of, in septicopyemia, 290.
- Irrigation of vagina**, use of, in diabetic vulvitis, 765.
- Irritants**, prohibition of, in food or drink in chancre of the lips, mouth, or tongue, 425.
- Irritating drugs**, employment of, to cause "abscess fixation" in pneumonia, 246.
- ITALIANS**, predisposition of, to rachitis, 815.
- ITALY**, introduction of vaccination into, 59; trial of antianthrax serum in, 332.
- ITCHING**, as a symptom of diabetes mellitus, 764.
- JAIL FEVER**. *See* Typhus fever.
- Jalap powder**, use of, in wood alcohol poisoning, 610.
- JAPAN**, history of vaccination in, 102.
- Japanese hand-stove**, use of, in typhoid fever, 23, 28.
- JAUREZ, PROF.**, theory held by, regarding delirium tremens, 602.
- JEFFERSON, PRESIDENT**, interest taken in vaccination by, 62.
- JENNER**, history of discovery of vaccination by, 57; inoculation experiments by, 92.
- JENNINGS, OSCAR**, method employed by, for treatment of morphinism, 623.
- JEQUIRITY SEED**, poisonous elements in, of a proteid character, 635.
- JESTY, BENJAMIN**, first inoculation of cow-pox for prevention of small-pox by, 57.
- JEWISH RACE**, liability to diabetes among, 719.
- JOHN OF GADDESSEN**, red light treatment of small-pox, suggested by, 51.
- JOINT PUNCTURE**. *See* Puncture.
- JOINTS**, affections of, as a complication of influenza, 194; local treatment of syphilitic lesions of, 430.
- JOSSERAND**, experiments by, on transmission of tuberculosis by vaccination, 90.
- JOUKOFFSKY**, vaccination by, of healthy children from syphilitic children without transmission of syphilis, 88.
- JÜRGENSEN**, use of alcohol in pneumonia advocated by, 230.
- Karrell's diet**, for reduction of obesity, 795.
- KEAN, DR.**, results of antityphoid vaccination in the U. S. Army reported by, 4.
- Keeley gold cure**, 600.
- KELALDITIS**, claim by, for making antitoxic serum for whooping-cough, 183.
- KELLAR**, investigations by, on causation of rachitis, 815.
- KEMP'S RECTAL IRRIGATORS**, 674.
- KENNEDY**, early report on small-pox inoculation by, 52.
- Kermes mineral**, use of, as an expectorant in pneumonia, 257.
- KERNIG'S SIGN**, presence of, in delirium tremens, 608.
- KETONURIA**, carbohydrates in treatment of, 756.
- KIDNEY, DISORDERS OF**, as a complication of diphtheria, 279; as a complication of measles, 161; due to arsenobenzol in treatment of syphilis, 415; due to hydrargyrisim, 385.
- KIDNEY, GOUTY**, 695.
- KIDNEYS, SYPHILITIC LESIONS OF**, local treatment of, 431.
- KILMARNOCK**, mortality from small-pox in, before and after vaccination, 96.
- KILMER**, method suggested by, for controlling paroxysms of whooping-cough, 178.
- KINK-COUGH**. *See* Whooping-cough.
- KLEIN**, post-mortem evidence of poisoning from canned fish reported by, 645.
- KLEIN AND DURHAM**, investigations by, showing difficulty in detecting micro-organisms causing food poisoning, 636.
- KNOFF**, window-tent devised by, for use in tuberculosis, 480.
- KNOFF'S SCHEDULE OF RULES**, for protection of children against tuberculosis, 460.
- KOCH, ROBERT**, discovery of tuberculin by, 509, 510.
- Koch's bacillen emulsion**, 512, 513.
- Koch's new tuberculin**, 512.
- Koch's old tuberculin**, 512.
- KORSAKOW'S PSYCHOSIS**, 609.
- Kraske-Riedel's treatment of erysipelas**, 285.
- KREATOTOXISMUS**. *See* Meat poisoning.
- KRUSE**, work by, on bacillus of dysentery, 317.
- KUSSMAUL**, report by, of syphilis transmitted by lancet used in vaccination, 88.

- KUSSMAUL'S BREATHING**, presence of, in diabetic coma, 732.
- LABIA MAJORA**, swelling of, as a complication of mumps, 166.
- Lactate of lime**, use of, in convalescence from pneumonia, 262.
- Lactic acid**, use of, in local treatment of laryngeal tuberculosis, 493.
- LACTONE**, use of, as a food in acute rheumatism, 298.
- LACTOSE**, presence of, in diabetic urine, 728; use of, as food in bacillary dysentery, 325; use of, as substitute for vegetable starch in diet of diabetics, 749.
- Lake mixture**, for use in local treatment of laryngeal complications of tuberculosis, 494.
- LAKTON**. *See* Glycoheptonic acid.
- LAMBERT, SIR ALEXANDER**, ergot in delirium tremens recommended by, 605; hyoscin, apomorphin, and strychnin in combination recommended by, as hypnotic in delirium tremens, 606; method of treating chronic alcoholism employed by, 597; method of treating morphinism employed by, 621; milk in typhoid fever forbidden by, 13.
- LANCEREAUX**, use of chloral in delirium tremens recommended by, 606.
- LANG**, use of metallic mercury in syphilis advocated by, 396.
- Lang's formula** for gray oil of mercury to be used in injection, 396.
- Lanolin**, as diluent for small-pox vaccine virus, 66; as a protective in employment of counterirritation, 159.
- LARKSPUR**, poisoning by, 652.
- LARYNGEAL COMPLICATIONS**, IN TUBERCULOSIS, 490; local treatment of, 492.
- LARYNGISMUS STRIDULUS**, as a complication of rachitis, 820.
- LARYNGITIS**, as a complication, of measles, 157; of small-pox, 51; of tuberculosis, 490.
- Larynx**, intubation of. *See* Intubation.
- LARYNX**, INVOLVEMENT OF, in diphtheria, 490; in tuberculosis, 490.
- Lassar's paste**, application of, to vaccinated arm, 73.
- LATHAM**, cases of tuberculosis considered suitable for sanatorium treatment by, 470; results reported by, of oral administration of tuberculin, 517.
- LATHYRISM**, 652; treatment of, 653.
- LAUNDRY**, care of, in tuberculosis, 437.
- Lavage, gastric**, use of, in acute alcoholism, 589; in acute dilatation of the stomach complicating pneumonia, 259; in barbel cholera, 644; in cheese poisoning, 647; in intestinal autoinfection complicated with arthritis, 681; in meat poisoning due to *B. botulinus*, 639; in meat poisoning due to *B. enteritidis*, 641; in meat poisoning due to *B. paratyphosus*, 642; in poisoning by *amanita phalloides*, 649; for relief of vomiting in infantile diarrhea, 329.
- LAVERAN AND CATRIN**, studies by, on bacteriology of mumps, 167.
- Laxatives**, sweetened, contraindicated in diabetes mellitus, 736.
- LEAD POISONING**, influence of, in causation of gout, 694.
- Leeches**, use of, in pneumonia, 256, 257; in pneumonia together with oxygen, 237.
- LEGRAIN**, use of convalescent serum by, in treatment of typhoid fever, 37.
- LEICHTENSTERN**, epidemic of psittacosis reported by, 584.
- Leiter coil**, use of, to reduce temperature in pneumonia, 232.
- Lemonade**, use of, in delirium tremens, 602, 603.
- LEPROSY**, as a complication of vaccination, 90.
- Leukocytic extract**, use of, in pneumonia, 244; value of, in cerebrospinal meningitis not determined, 201.
- LEURIAUX**, claim for making an antitoxic serum for whooping-cough made by, 183.
- LEVULOSE**, subcutaneous injection of, in diabetic coma, 758; use of, to prevent acidosis in diabetes mellitus, 757; use of, as substitute for vegetable starch in diabetes mellitus, 748; presence of, in diabetic urine, 728.
- LEVULOSURIA**, conditions governing, 728.
- LEVY-BING**, direct parasitic action of mercury established by, 381.
- LEWIN**, toxic symptoms following therapeutic use of phosphorus reported by, 627.
- LEYDEN**, mixture suggested by, for rectal feeding in tetanus, 350.
- LITTLE, DUNCAN**, chicken-pox first distinguished from small-pox by, 109.

- LIEBEN'S TEST**, for acetone in the urine, 733.
- LIEBERMEISTER**, on use of cold wet pack in typhoid, 18.
- Ligation of limbs**, for control of hemorrhage in pulmonary tuberculosis, 501.
- Light, protection from**, as a therapeutic measure in varicella, 112.
- Light therapy**, use of, in diabetes insipidus, 777.
- Liniment**, of ether, chloroform, and menthol, for relief of neuralgic pain following withdrawal of morphin, 624.
- Liquor potassii arsenitis**, use of, in nervous type of influenza, 191.
- LITHEMIA**, 697.
- Lithium carbonate**, use of, in diabetes mellitus, 760.
- Lithium citrate**, use of, in diabetes mellitus, 760.
- LIVER**, disturbances of, associated with intestinal autointoxication, 679.
- LIVER ABSCESS**, as a complication of influenza, 190.
- LOBAR PNEUMONIA**. *See* Pneumonia.
- LOCO WEEDS**, poisoning by, 652.
- LOEFFLER AND FROSCH**, work by, on prophylactic serum for foot and mouth disease, 583.
- LOLIUM TEMULENTUM**. *See* Darnel.
- Loomis sanatorium**, experiments performed in, concerning dosage of tuberculin, 522; experiments performed in, showing condition of gastrointestinal tract in tuberculosis, 559; menus for meals served in, 552; menus for meals in two-hour diet employed in, 554; percentage of patients having otitis media at, 509; records of tuberculin therapy kept in, 518; statistics of laryngeal complications in tuberculosis kept in, 490; test diet for tuberculous patients employed in, 502.
- LOTT**, hyoscin first used by, in treatment of morphinism, 620.
- LUGOL'S TEST**, for acetone in the urine, 733.
- Lumbar puncture**. *See* Puncture.
- Lunar caustic**, objections to use of, in chancre, 422.
- LUPINUS**, poisoning by, 651.
- LUPUS**, as a complication of vaccination, 90.
- LÜTHJE, H.**, on causation of gout, 693.
- LYMPHATIC GLANDS, ENLARGEMENT OF**, as a complication of measles, 161; treatment of, 162.
- Lysol**, injections of, in solution, in chancre with phimosis, 423; irrigation of the bowel with a solution of, in the chronic stage of bacillary dysentery, 328; use of, as a disinfectant, in tuberculosis, 452, 453; use of, as a lotion in pustular or ulcerative syphiloderms, 426.
- MAGDEBERG EXPERIMENTS**, on frequency of syphilis, 370, 373.
- Magnesia, milk of**, use of, as mouth wash in diabetes mellitus, 736.
- Magnesium citrate**, use of, to empty the gastrointestinal tract in pneumonia, 227.
- Magnesium perhydrol**, use of, in diabetes mellitus, 760.
- Magnesium sulphate**, use of, in acute alcoholism, 589; in bacillary dysentery, 326; in chronic alcoholism, 595; in constipation accompanying Rocky Mountain fever, 565; by rectum in diabetic coma, 757; tetanus cases treated by subdural injection of, 352; in treatment of tetanus, 349; in wood alcohol poisoning, 610.
- MAGNUS-LEVY**, on diabetic bread, 747.
- MALIGNANT PUSTULE**, 330.
- Malt**, use of, in convalescence from pneumonia, 262.
- MALTOSE**, presence of, in diabetic urine, 728.
- MAMMARY GLAND**, swelling of, as a complication of mumps, 166.
- Mannite**, use of, to prevent acidosis in diabetes mellitus, 757.
- MARAGLIANO**, 5 per cent. solution of phenol recommended by, for use in tetanus, 349.
- MARAGLIANO'S antituberculosis serum**, 525.
- MARCOLINI**, transmission of syphilis by means of vaccination reported by, 88.
- MARINE CLIMATES**, tuberculous children benefited by, 473.
- MARINE HOSPITAL SERVICE**, rules issued by, for disinfection in tuberculosis, 454.
- Marital prophylaxis against syphilis**, 376.
- Marmorek's antistreptococcic serum**, use of, in scarlet fever, 128.
- Marmorek's antituberculosis serum**, 525.
- MARRIAGE**, question of, in diabetes mellitus, 769; in tuberculosis, 464.

- MARTIN**, use of pilocarpin in mumps advised by, 172.
- MASSACHUSETTS**, antituberculosis work in, 445.
- MASSACHUSETTS GENERAL HOSPITAL**, disinfection of typhoid urine and stools at, 8; mortality from typhoid fever at, 15, 19; results of administration of urotropin in pneumonia at, 223; results of anti-typhoid vaccination at, 5; rules for prevention of typhoid extension in, 7; study of influenza at, 188; technique of anti-typhoid vaccination at, 6.
- Massage**, use of, in after-treatment of morphinism, 624; in alcoholism, 594; in arthritis associated with intestinal auto-intoxication, 681; in arthritis deformans, 712; in chronic gout, 700; in chronic opium poisoning, 619; in chronic rheumatism, 712; in convalescence from influenza, 196; in convalescence from pneumonia, 262; in hallucinosis of drunkards, 609; in Korsakow's psychosis, 609; in mumps, 170; in muscular weakness accompanying rachitis, 818; necessity for caution in use of, for phlebitis complicating typhoid fever, 28; in nervous type of influenza, 191; in paralysis following cerebrospinal meningitis, 214; in reduction of obesity, 807; in syphilitic arthritis, 306.
- MASTITIS**, as complication of typhoid fever, 28.
- MATCH FACTORIES**, chronic phosphorus poisoning in, 628; means of preventing phosphorus poisoning in, 629.
- MATCHES, PHOSPHORUS**, suicide by means of, 626.
- MAURIAC**, passage of iodine through the system demonstrated by, 405.
- Maw's improved inhaler**, for use in laryngeal complications of tuberculosis, 492.
- McBRIDE**, directions by, for atropin and strychnin treatment of alcoholism, 595, 596.
- MEALS**, arrangement of, in treatment of obesity, 797; menus for, in treatment of tuberculosis, 547.
- MEASLES**, 138; admission of light in, 147; antipyretics in, 150; asthenic form of, 153; bacteriology of, 138; bronchitis complicating, 153; bronchopneumonia complicating, 158; care of mouth in, 148; cleanliness important in, 147, 150; complications of, 156; contagiousness of, during period of eruption, 143; contagiousness of, during period of invasion, 141; cough as a symptom of, 152; diagnosis between, and typhus fever, 38; diet in, 148; enterocolitis complicating, 160; eruption in, 142; eruption in hemorrhagic form of, 154; exaggerated form of, 149; fresh air treatment of, 146, 159; genital disorders complicating, 161; hemorrhagic form of, 154; hydrotherapy in, 149, 152; hygienic treatment of, 145; immunity conferred by, 140; intestinal disorders complicating, 160; laryngeal disorders complicating, 157; lymph glands enlarged in, 161; mortality in asthenic form of, 154; mortality from bronchopneumonia in, 158; mouth diseases complicating, 157; mucous membranes in, and their diseases complicating, 156; nervous symptoms of, 152; nose affections complicating, 152, 156; non-contagiousness of, during period of desquamation, 143; non-contagiousness of, during period of incubation, 141; other infectious diseases complicating, 161; pharyngeal affections complicating, 156; physician's duty as regards infection in, 139; as a predisposing cause of rachitis, 814; prevention of, in hospitals, 144; prevention of, in schools, 144; prophylaxis of, 139; prophylaxis of, in private practice, 145; rare complications of, 161; rules applying to prophylaxis of, 141; sequelæ to, 162; sickroom in, 146; symptomatic treatment in, 148; temperature in, 142, 149; treatment of, 145; ventilation during, 146.
- MEASLES, GERMAN**, 164; treatment of, 165.
- MEAT**, use of, in diabetes mellitus, 744.
- MEAT POISONING**, 637; by *B. anthracis*, 330; by *B. botulinus*, 638; by *B. Breslaviensis*, 641; by *B. enteritidis*, 640; by *B. Friedebergensis*, 641; by *B. paratyphosus*, 642; by *B. pneumoniae*, 643; by *B. proteus vulgaris*, 642; by *B. sui septicus*, 642.
- Mechanotherapy**, in chronic gout, 700; in reduction of obesity, 805.
- "MEDICAL" ERYSIPELAS**, 282.
- MEDICAL PROFESSION**, influence of, toward proper use of alcohol, 593.

- Medinal**, use of, for restraint of delirium in pneumonia, 228.
- MEHNERT**, effect of vaccination on whooping-cough in young infants reported by, 74.
- MELTZER**, on causes of acute dilatation of the stomach in pneumonia, 260.
- MENINGITIS**, as a complication of acute rheumatism, 304; as a complication of erysipelas, 285; as a complication of influenza, 193; as a complication of mumps, 171; as a complication of pneumonia, 259; diagnosis between, and typhus fever, 39.
- MENINGITIS, CEREBROSPINAL.** *See* Cerebrospinal meningitis.
- MENINGITIS, INFLUENZAL.** *See* Influenzal meningitis.
- MENINGITIS, PNEUMOCOCCUS AND STREPTOCOCCUS**, 210.
- MENSTRUAL DISTURBANCES**, in tuberculosis, 507.
- MENTAL APATHY IN DIPHTHERIA**, 269, 270.
- Menthol**, local use of, for disinfection of mouth in measles, 148; for relief of cough in pulmonary tuberculosis, 497; for relief of itching complicating diabetes mellitus, 764; for relief of itching in small-pox, 49; for relief of itching in varicella, 112.
- Menthol, alcoholic solution of**, for relief of tender toes in typhoid fever, 29.
- Mentholated lozenges**, use of, to relieve cough in pulmonary tuberculosis, 497.
- Menzer's antistreptococcic serum**, use of, in scarlet fever, 128.
- Mercolint aprons**, administration of mercury by, in syphilis, 390.
- Mercurial baths.** *See* Bath.
- Mercurial dusting powders**, use of, in secondary syphilis of the mucosæ and mucocutaneous surfaces, 426.
- Mercurial flannels**, administration of mercury by, in syphilis, 390.
- Mercurial ointments**, use of, in chancre of general integument, 425; in chancre of lips, 425; in chancre of the rectum, 424; in gummata, 430; in hereditary syphilis, 434; in macular and papular syphiloderms, 425; in palmar and plantar syphilids, 430; in papular or tubercular tertiary lesions of syphilis, 426; as a prophylactic measure in syphilis, 373; in pustular and ulcerative syphiloderms, 426; in syphilitic arthritis, 306; in syphilitic condylomata, 428; in syphilitic lesions of bones and joints, 430; in syphilitic onychia, 429.
- Mercurial preparations**, suitable for use in syphilis, 385.
- MERCURIAL STOMATITIS**, due to hydrargyris, 384; treatment of, 385.
- Mercury, injection of insoluble salts of**, 394; calomel, 396; gray oil, 396; early use of method, 394; injection fluid, 397; injection implement, 399; injection site, 400; objections, 402; preparations used, 397; salicylate, 397; sterilization of needle, 400; technique of injection, 401; theory, 395.
- Mercury in syphilis**, 380; absorption of, 382; action of, 381; administration of, by mouth, 385; administration of, in general, 388; continuous intermittent treatment with, 418; continuous treatment with, 417; cutaneous administration of, 387; danger of, in diabetes associated with syphilis, 768; elimination of, 382; in hereditary syphilis, 433; hydrargyris from excessive use of, 383; injection method of administering, 390; insoluble injections of, 394; inunction method of administering, 387; inunction method desirable in infants, 434; "mixed" form of treatment with, 385, 410; in pregnancy, 431; preparations of, suitable for, 385; rectal administration of, 387; soluble injections of, 392.
- Mercury, ammoniated**, use of, in exulcerated chancre, 423.
- Mercury benzoate**, use of, in syphilis, 394.
- Mercury bichlorid**, hypodermic use of, in papular or tubercular tertiary cutaneous lesions of syphilis, 426; in syphilis, 393.
- Mercury bichlorid**, local use of, in chancre of the general integument, 425; in exulcerated chancre, 422; in gangrenous chancre, 423; as gargle in chancre of the mouth and tongue, 425; in gummata, 430; in mucous patches, 427; in papular and tubercular tertiary lesions of syphilis, 426; in pustular and ulcerative syphiloderms, 426; in small-pox, 49; in syphilitic alopecia, 429; in syphilitic onychia, 429; in tertiary syphilitic lesions of mucous or mucocutaneous surfaces,

- 427; in throat affections complicating scarlet fever, 130.
- Mercury bichlorid**, objections to, as disinfectant for tuberculous sputum, 453.
- Mercury bichlorid**, use of, by irrigation, for abscess of the cervical glands, 247; for chancre of the vagina or uterine neck, 425; in chronic stage of bacillary dysentery, 328; for mucous patches on the genitalia, 427.
- Mercury bichlorid**, use of, by mouth, in syphilis, 386.
- Mercury, biniodid**, use of, in scarlet fever, 124; in syphilis, by mouth, 387; in syphilis by hypodermic injection, 393.
- Mercury cacodylate**, use of, in syphilis, 394.
- Mercury chlorid**. *See* Calomel.
- Mercury cyanid**, use of, in syphilis, 394.
- Mercury, gray oil of**, use of, in syphilis, by intramuscular injection, 396; by rectal injection, 387.
- Mercury lactate**, use of, in syphilis, 394.
- Mercury, metallic**, use of, in syphilis, 396.
- Mercury oleate**, use of, in administration of mercurial plasters, 390; in administration of mercury by inunction, 388; in chancre of the general integument, 425; in macular and papular syphiloderms, 425.
- Mercury peptonate**, use of, in syphilis, 394.
- Mercury protiodid**, use of, in syphilis, 386.
- Mercury salicylate**, use of, in syphilis, 397.
- Mercury tannate**, use of, in hydrargyrisms affecting the kidneys, 385; in syphilis, 387.
- Mercury, white precipitate of**, use of, in mercurial plasters, 390.
- Mercury with chalk**, use of, in hereditary syphilis, 434; in syphilis, 386.
- Mercury, yellow oxid of**, use of, in care of eyes in small-pox, 50.
- METABOLIC DISORDERS**, associated with intestinal autointoxication, 680.
- Metallic ferments**, use of, in treatment of pneumonia, 246.
- METCHNIKOFF**, experiments by, on causation of arterial sclerosis, 679.
- METCHNIKOFF and ROUX**, demonstration by, that anthropoid apes are susceptible to syphilis, 362; experiments by, on prophylactic measures in syphilis, 373.
- METEORISM**, in typhoid fever, 26.
- METHYL ALCOHOL**. *See* Wood alcohol.
- Methyl salicylate**, local application of, in mumps, 170.
- Methylene blue**, irrigation of the bowels with a solution of, in the chronic stage of bacillary dysentery, 328; use of, to relieve sciatic pain in diabetes mellitus, 766.
- Mezereon ointment**, use of, in syphilitic iritis, 429.
- MICHIGAN**, antituberculosis work in, 446.
- MIDDLE EAR**, importance of protecting, in influenza, 189.
- "MIGRATING CASES,"** in erysipelas, 283.
- MILIARY FEVER**, 578; characteristics of, 578; convalescence from, 578; definition of, 578; eruption in, 578; mortality from, 579; prophylaxis against, 579; quarantine in, 579; treatment of, 579.
- MILK**, as an article of diet in typhoid fever, 12; boiled, as factor in causation of rickets, 816; condensed, rachitis due to long-continued use of, 817; dried, long-continued use of, a cause of rachitis, 817; hot, use of, for relief of cough in pulmonary tuberculosis, 497; objections to, in diet of acute dysentery, 325; objections to, in diet of chronic dysentery, 328; sterilized, as factor in causation of rickets, 816; transmission of dysentery by, 319; transmission of foot and mouth disease by, 582; transmission of scarlet fever by, 116; transmission of typhoid fever by, 2, 3; use of, in diabetes mellitus, 742.
- MILK AND MILK PRODUCTS**, poisoning by, 645.
- Milk diet**, in delirium tremens, 603; in diphtheria, 275; in influenza with gastrointestinal symptoms, 190; in nephritis complicating scarlet fever, 133, 134; in pneumonia, 229; in scarlet fever as preventive of nephritis, 133; in small-pox, 46; in whooping-cough, 179; in wood alcohol poisoning, 610.
- Milk of magnesia**. *See* Magnesia.
- MILK SUGAR**. *See* Lactose.
- Mineral acids**, action of, on glandular secretion in severe infections, 25.
- Mistura ferri et ammonii acetatis**. *See* Basham's mixture.
- Mitten friction**, use of, to reduce temperature in pneumonia, 233.
- Mixed treatment**, administration of mercury and iodine together by, in syphilis, 410; use of, in hereditary syphilis, 434; use of, in pregnancy, 432.

- MOHN**, disinfection of sick room as means of curtailing whooping-cough advocated by, 179.
- MOLDS**, as cause of pellagra, 657.
- MONKEYS**, reaction of, to vaccination and small-pox, 93.
- MONTAGUE, LADY MARY WORTLEY**, inoculation for small-pox introduced by, 52.
- Morphin**, use of, in acute gout, 703; in bacillary dysentery, 327; in combination with atropin, in treatment of nephritis complicating scarlet fever, 133; in combination with hyoscin, for relief of insomnia in typhoid fever, 27; in combination with digitalin and strychnin, in delirium tremens, 607; contraindicated in bronchopneumonia complicating influenza, 192; contraindicated in cough of pulmonary tuberculosis, 498; contraindicated in nervous symptoms complicating measles, 152; to control cough during active stage of tuberculosis, 482; to control hemorrhage in pulmonary tuberculosis, 500; in enterocolitis complicating measles, 161; in hydrophobia, 342; before intubation of the larynx, 275; in pneumonia of alcoholics, 258; in pulmonary edema complicating pneumonia, 259; for relief of dyspnea in tuberculosis, 506; for relief of gastric irritability in typhoid fever, 25; for relief of headache in typhoid fever, 27; for relief of hemorrhage in typhoid fever, 19; for relief of hic-cough complicating pneumonia, 260; for relief of insomnia in influenza, 192; for relief of insomnia in typhoid fever, 26; for relief of pain in acute polymyositis, 685; for relief of pain in acute rheumatism, 297; for relief of pain in cerebrospinal meningitis, 213; for relief of pain in the chest accompanying tuberculosis, 506; for relief of pain in muscarin poisoning, 648; for relief of pain and cough in pneumonia, 227; for relief of pain in Rocky Mountain fever, 565; for relief of pain in septicemia, 291; for relief of pain in small-pox, 47; in respiratory type of influenza, 189; for restraint of delirium in pneumonia, 228; in tetanus, 348; in treatment of morphinism, 618, 623.
- MORPHIN ADDICTION**, 617; diet in treatment of, 619; effects of, in the East, 614; Hirschlaff's heil-serum for cure of, 624; hygienic measures in treatment of, 624; hypnotism in treatment of, 624; Jennings' method of treating, 623; Lambert's method of treating, 621; methods of practicing, 616; Town's specific treatment of, 621; treatment of, in general, 617.
- MORTALITY**, from the asthenic form of measles, 154; from bronchopneumonia complicating influenza, 192; from bronchopneumonia complicating measles, 158; from bronchopneumonia complicating whooping-cough, 175; from delirium tremens, 607; from diabetes mellitus, 718; from glandular fever, 577; from miliary fever, 579; from pneumonia, 218, 234; from psittacosis, 586; from psittacosis among parrots, 585; from small-pox before vaccination, 54, 93; from small-pox since vaccination, 93; from small-pox in vaccinated and unvaccinated, 94; from small-pox with and without vaccination scars, 75; from tetanus, 350; from tuberculosis, 450; from tuberculosis treated with tuberculin, 523; from typhoid fever, 15, 19, 23; from typhus fever, 37; from Weil's disease, 571.
- MORTALITY**, effect of serum treatment upon, in anthrax, 332; in dysentery, 321.
- MORTALITY**, effect of tuberculin upon, in tuberculosis, 523.
- MORTALITY**, effect of vaccination upon, in small-pox, 93.
- MORTON**, on the production of artificial pneumothorax in tuberculosis, 535.
- Moser's antistreptococcic serum**, use of, in scarlet fever, 129.
- MOUTH, CARE OF**, in diabetes mellitus, 736; in measles, 148; in meat poisoning, 639; in pellagra, 662; in pneumonia, 221; in syphilis, 368; in varicella, 113.
- Mouth wash**, for use in lobar pneumonia, 222; in mumps, 170; in Rocky Mountain fever, 565; in stomatitis due to hydrargyrisim, 385; in syphilis, 369.
- MUCOCUTANEOUS JUNCTIONS**, treatment of secondary syphilitic lesions of, 426; treatment of tertiary syphilitic lesions of, 427.

- Mucosæ**, treatment of secondary syphilitic lesions of, 426; treatment of tertiary syphilitic lesions of, 427.
- MUCOUS MEMBRANES OF THROAT**, swelling of, in mumps, 171.
- MUCOUS PATCHES**, local treatment of, 427.
- MUMPS**, 166; complications in, 166; definition of, 166; diet in, 169; epidemics of, 168; epididymitis complicating, 166, 171; general considerations on, 166; history of, 167; immunity conferred by, 169; incubation period in, 168; infectiousness of, 168; inflammation of mammary gland complicating, 166; inflammation of ovaries complicating, 166; operative measures in, 171; orchitis complicating, 166, 171; organism found in, 167; prophylaxis of, 169; ptyalism complicating, 171; suppuration complicating, 171; susceptibility to, 167; synonyms for, 166; transmission of, 168; treatment of, 169.
- MURPHY**, production of artificial pneumothorax in tuberculosis advocated by, 535.
- Murphy drip method**, sodium bicarbonate given by, in diabetic coma, 757.
- MURRELL**, on polyarticular character of gonococcic arthritis in children, 306.
- MURRELL AND HICKS**, bacillus obtained by, from gleet discharges, 295; on bacillus found in gonococcic arthritis, 306.
- MUSCARIN**, as a cause of food poisoning, 635.
- MUSCLES**, SYPHILIS OF, 685; treatment of, 686.
- MUSCULAR CRAMPS**, 689.
- MUSCULAR RHEUMATISM**, 688.
- MUSCULAR WEAKNESS**, accompanying rachitis, 818.
- MUSHROOM FAMILY**, poisoning by members of, 647.
- Musk**, use of, for relief of hiccough complicating pneumonia, 260.
- MUSSEL POISONING**, 645.
- Mustard**, use of, as emetic in acute opium poisoning, 614.
- Mustard foot-baths**, use of, in pulmonary edema complicating pneumonia, 259.
- Mustard plasters**, use of, to relieve pain in the chest accompanying tuberculosis, 506; over trachea and bronchi for relief of cough in pulmonary tuberculosis, 497.
- MUTTON**, meat poisoning due to, 638.
- MYALGIA**. *See* Muscular rheumatism.
- MYCETISMUS**, 647.
- MYOCARDITIS**, as a complication of diphtheria, 276.
- MYOSITIS, VARIOUS FORMS OF**, 684; acute polymyositis, 684; muscular cramps, 689; muscular rheumatism, 688; myositis fibrosa, 687; myositis ossificans, 687; primary suppurative myositis, 686; secondary suppurative myositis, 687; syphilis of muscles, 685; tuberculous myositis, 687.
- MYTILOTOXIN**, as a cause of food poisoning, 635.
- MYTILOTOXISMUS**. *See* Mussel poisoning.
- NÄGELE**, method suggested by, for cutting short paroxysm of whooping-cough, 179.
- Naphthalin**, use of, as an antiseptic in intestinal autointoxication, 675.
- Narcotic drugs**, symptoms due to misuse of, in whooping-cough, 175.
- NASTURTIUM OFFICINALE**. *See* Watercress.
- NAUNYN'S "STARVATION DAYS,"** 753.
- Neapolitan method of vaccination**, 60.
- Neapolitan ointment**, use of, in administration of mercury by inunction, 388; in hereditary syphilis, 434.
- NECROSIS OF JAW**, due to phosphorus poisoning, 628.
- NEGRI**, work on vaccination by, 60.
- NEGROES**, predisposition of, to rachitis, 815.
- NEISSER**, contagiousness of tertiary syphilitic lesions established by, 371.
- NEPHRITIS, AS A COMPLICATION OF:** German measles, 165; glandular fever, 577; influenza, 194; lobar pneumonia, 261; Rocky Mountain fever, 566; scarlet fever, 132; Weil's disease, 572.
- "NEPHROTYPUS,"** 24.
- NERVOUS SYSTEM**, disease of, and use of arsenobenzol in syphilis, 415.
- NERVOUS STRAIN**, influence of, in causation of alcoholism, 590.
- NERVOUS TYPE OF INFLUENZA**, 190.
- NEURALGIA**, as a complication of acute rheumatism, 304; diabetic, *see* Diabetic neuralgia.
- NEURASTHENIA**, associated with intestinal autointoxication, 682.
- NEURIN**, as a cause of food poisoning, 635.
- NEURITIS**, brachial, as symptom of diabetes mellitus, 766; diabetic, *see* Diabetic neuritis; due to administration of arsenic in

- syphilis, 415; due to hydrargyris in syphilis, 384.
- NEURITIS, OPTIC**, due to arsenobenzol administered in syphilis, 415; due to wood alcohol poisoning, 610.
- NEW JERSEY**, antituberculosis work in, 446.
- NEW YORK CITY**, antituberculosis work in, 447; means of house disinfection in, 452.
- NEW YORK CITY HEALTH DEPARTMENT**, experiments performed by, on effects of cauterization for rabies, 336; Pasteur antirabic virus sent by mail from, 341; preparation of antirabic virus by, 338; record by, of immunization with diphtheria antitoxin, 268.
- NEWSHOLME**, investigations by, on decreased death rate from phthisis, 439, 441.
- Nicotin**, use of, in tetanus, 348.
- NIGHT SWEATS**, in tuberculosis, 505.
- Nitric acid, fuming**, results of, in treatment of bite by rabid animal, 336.
- Nitrites**, use of, to relieve vascular pain in ergotism, 652.
- Nitrogen**, injection of, into pleural cavity, 535; method employed in, 536.
- Nitroglycerin**, use of, to control hemorrhage from pulmonary tuberculosis, 500; dangerous in pneumonia, 248; in diabetic coma, 757; hypodermically, in diphtheria, 277; for relief of dyspnea in tuberculosis, 506; in scarlet fever with cardiac weakness, 127.
- NOCARD**, isolation by, of bacillus supposed to be cause of psittacosis, 584.
- NON-DIPHThERIC CROUP**. *See* Croup.
- Normal saline solution, injection of**. *See* Injection.
- NORWAY**, introduction of vaccination into, 60.
- NOSE, AFFECTIONS OF**, as a complication of diphtheria, 272; of measles, 156; of scarlet fever, 129.
- Nose irrigation**, in diphtheria, 271, 272; otitis media caused by, 277.
- NOSE AND THROAT**, care of, a means of preventing acute rheumatism, 296.
- NOSE-BLEED**. *See* Epistaxis.
- NOTHNAGEL**, tables by, showing mortality from small-pox, after vaccination, 100.
- NOTIFICATION**, value of, in control of tuberculosis, 447.
- NURSE**, duty of, in acute rheumatism, 296; in pneumonia, 222; in prevention of small-pox, 44; in scarlet fever, 119.
- NURSING OF INFANT**, possibilities of infection through, in syphilis, 432; in tuberculosis, 457.
- NUTRITION**, changes in, due to pneumonia, 228.
- Nuts**, use of, in diabetes mellitus, 744.
- Nux vomica**, use of, as tonic in tuberculosis, 504.
- Oatmeal diet**, value of, in after-treatment of diabetic coma, 758.
- Oatmeal treatment of diabetes mellitus**, 753.
- OBESITY**, 779; alcohol in treatment of, 805; arrangement of meals in treatment of, 797; Bouchard's method for reduction of, 794; calisthenics in treatment of, 807; causes of, stated by von Noorden, 784; choice of cases for reduction of, 787; comparison of diets for reduction of, 796; definition of, 779; dietetic treatment of, 790; Epstein diet for cure of, 791; exercise in treatment of, 806; foods allowable in, 800; foods to be avoided or restricted in treatment of, 800; functions of different foods in relation to, 782; general considerations in treatment of, 788; general principles of diet in, 796; Harvey-Banting cure for, 790; health resorts for treatment of, 789, 809; heat loss in relation to treatment of, 784; heredity in causation of, 785; Hirschfeld's diet for reduction of, 794; hydrotherapy in reduction of, 808; Harrell's diet for reduction of, 795; limitation of fluids in treatment of, 805; massage in treatment of, 807; mechanotherapy in reduction of, 805; medicinal treatment of, 808; menus for meals used in reduction of, 799; Oertel cure for, 792; passive mechanical exercises in reduction of, 807; physiology of, 781; prophylaxis against, 786; Robin's diet for reduction of, 793; Schweninger system for reduction of, 793; secretion of sexual organs in relation to, 786; sedentary life in causation of, 785; Spa treatment of, 809; thyroid gland in reduction of, 786, 809; treatment of, after reduction, 810; treatment of, in general, 787; von Noorden's system for reduction of, 794.
- OCCUPATION**, choice of, in tuberculosis, 463; influence of, in causation of gout, 694.

- OCCUPATIONS** favoring transmission of syphilis, 372, 375.
- OCULAR AFFECTIONS**, associated with intestinal autoinfection, 682.
- Oertel cure**, the, for obesity, 792.
- Oil of sylvestrian pine**, use of, in gangrene of the lung complicating pneumonia, 261.
- Oil of turpentine**. *See* Turpentine.
- Ointments**, use of antiseptics by means of, in small-pox, 50; in care of eyes during small-pox, 50; use of mercury by, in syphilis, *see* Mercury; use of salicylic acid by, for vaccinated arm, 73.
- Oleum phosphoratus**, use of, in rachitis, 818, 819.
- ONDREJOVICH'S TEST**, for diacetic acid in the urine, 733.
- ONYCHIA**, SYPHILITIC, local treatment of, 429.
- Open air**, importance of, during active stage of tuberculosis, 479, 480.
- Open-air treatment**, in bronchopneumonia complicating diphtheria, 278; in measles, 146, 159; in pneumonia, 224; in septicopyemia, 290.
- Operative measures**, employment of, for abscess of the lung complicating pneumonia, 261; in actinomycosis, 360; in arthritis deformans, 714; in bacillary dysentery at the chronic stage, 328; in cervical adenitis complicating diphtheria, 277; in chancre of the general integument, 425; in chancre with phimosis, 424; danger of, in exophthalmic goiter complicated with diabetes mellitus, 767; in chancre, 423; for hemorrhage, in typhoid fever, 21; for necrosis of the jaw due to phosphorus poisoning, 630; for phagedenic chancre, 423; for pleurisy with effusion complicating pneumonia, 261; for rectal chancre, 425.
- Opiates**, use of, in barbel cholera, 644.
- Opium**, use of, to control cough during the active stage of tuberculosis, 482; to control cough in laryngeal complications of tuberculosis, 491, 498; in diabetes insipidus, 777; in diabetes mellitus, 759; in diabetic gangrene, 770; in enterocolitis complicating measles, 160; in gastro-intestinal type of influenza, 190; for relief of cough in measles, 153; for relief of diarrhea in typhoid fever, 26; for relief of insomnia in typhoid fever, 26; for relief of pain in acute gout, 703; for relief of pain in infantile diarrhea, 329; for relief of pain in meat poisoning by *B. enteritidis*, 641; in scarlet fever, 127; in tuberculosis of the intestines, 505.
- Opium and ipecac**, use of, for relief of pain in pneumonia, 227.
- OPIUM EATERS**, 616.
- OPIUM POISONING**, 614; acute form of, 614; chronic form of, 616; effects of chronic form of, on Eastern races, 614; opium eating and, 616; opium smoking and, 616; treatment of acute form of, 614; treatment of chronic form of, 617.
- OPIUM SMOKING**, 616.
- Opothorapy**, employment of, in diabetes mellitus, 760; in syphilis, 436.
- ORCHITIS**, as a complication of mumps, 166; as a complication of typhoid fever, 27; treatment of, in mumps, 171.
- Organic extracts**, use of, in diabetes insipidus, 778; in diabetes mellitus, 760; in treatment of obesity, 809.
- Organotherapy**, use of, in rachitis, 818.
- Orthoform**, use of, in small-pox accompanied by dysphagia, 46.
- Orthopedic treatment**, unnecessary in early stages of rachitis, 819.
- OTITIS**, as a complication of scarlet fever, 130; of typhoid fever, 28.
- OTITIS MEDIA**, as a complication of diphtheria, 277; organism causing, 278; treatment of, 278.
- OTITIS MEDIA**, as a complication of measles, prevention of, 156.
- OTITIS MEDIA**, as a complication of tuberculosis, 509.
- OVARIES**, swelling of, as a complication of mumps, 166.
- "OXIDATION TEMPERATURE,"** 485.
- Oxygen**, hypodermic injections of, in pneumonia with asphyxia, 237.
- Oxygen inhalations**, use of, in bronchopneumonia complicating measles, 159; in diabetic coma, 757; in lung complications of Rocky Mountain fever, 566; in pneumonia, 236; to relieve dyspnea in tuberculosis, 506; in tetanus, 350.
- OYSTERS**, transmission of typhoid fever by, 3.
- Pack, blanket**, use of, to reduce temperature in pneumonia, 233.

- Pack, cold**, use of, in after-treatment of morphinism, 624; in delirium tremens, 606; to reduce temperature in pneumonia, 231; to reduce temperature in Rocky Mountain fever, 565; to reduce temperature in scarlet fever, 126; in typhoid fever, 18.
- Pack, hot**, use of, in after-treatment of morphinism, 624; in delirium tremens, 602; in nephritis complicating Rocky Mountain fever, 566; in nephritis complicating scarlet fever, 134.
- Pack, hot dry**, use of, in acute polymyositis, 685.
- Pack, warm**, use of, in scarlet fever, 126.
- PAIN**, relief of, a cause of morphinism, 616.
- PANCREAS**, relation between removal of, and diabetes mellitus, 720.
- Pancreatic extract**, use of, in diabetes mellitus, 760.
- Pantopon**, use of, in diabetes mellitus, 759.
- Paquelin cautery**. *See* Cautery.
- PARADYSENTERY GROUP OF BACILLI**, 317.
- Paraldehyd**, in delirium tremens, 607; in pneumonia of alcoholics, 258.
- PARALYSIS**, after cerebrospinal meningitis, 214; due to Korsakow's psychosis, 609.
- PARATHYROIDS**, supposed relation between disturbance of, and rachitis, 813.
- Paregoric**, use of, in typhoid fever, 26.
- PAROTITIS**, as a complication of typhoid fever, 27.
- PAROTITIS EPIDEMICA**. *See* Mumps.
- PARROTS**, association of, with psittacosis, 584.
- Passive mechanical exercise**, in treatment of obesity, 807.
- PASTEUR INSTITUTE OF PARIS**, results of Pasteur treatment at, 341.
- Pasteur treatment of hydrophobia**, 334; complications in, 340; duration of, 339; indications for, 334; invention of, 337; local and constitutional effects of, 339; mortality from rabies affected by, 342; preparation of antirabic virus used in, 338; results of, 341; technique of administration of, 337; use of, by mail, 341.
- PASTEURIZATION OF MILK**, as a protection against tuberculosis, 457; risks associated with, 646.
- Pasteur's method**, of immunization for anthrax, 331.
- PATERSON, MARCUS**, method employed by, for gauging effects of exercise on tuberculous patients, 528; scientific principle of exercise in tuberculosis discovered by, 527; system of graduated labor developed by, 528, 529; system of rest during active stage of pulmonary tuberculosis introduced by, 483.
- PEDICULUS VESTIMENTORUM**, transmission of typhus fever by, 32.
- PELLAGRA**, 657; causation of, 657; diet in, 661; drugs in, 659; fulminating form of, 660; hemorrhage complicating, 662; hydrotherapy for, 662; institutions for care of, 662; prophylaxis of, 657; treatment of, 659.
- PEMPHIGUS**, as a complication of vaccination, 91.
- PENNSYLVANIA**, antituberculosis work in, 446.
- PENTOSE**, presence of, in diabetic urine, 728.
- PENTOSURIA**, conditions governing, 729.
- PERFORATION OF THE INTESTINE**, occurrence of, in typhoid fever, 22.
- PERICARDITIS**, as a complication of pneumonia, 261.
- PERIODIC ALCOHOLISM**, 591.
- PERIOSTITIS**, as a complication of typhoid fever, 27.
- PERNET**, observations by, on pemphigus following vaccination, 91.
- Perspiration, stimulation of**, in treatment of intestinal autointoxication, 672.
- PERTUSSIS**. *See* Whooping-cough.
- Petrolatum**, external use of, in small-pox, 50.
- PFEIFFER**, discovery of influenza bacillus by, 184; glandular fever first described by, 574.
- PHALLIN**, 649.
- PHARYNX**, disorders of, a complication of measles, 156; irrigation of, in diphtheria, 271; otitis media caused by irrigation of, 277.
- Phenacetin**, use of, in acute rheumatism, 301; in erysipelas, 284; in gastrointestinal type of influenza, 190; in influenza, 187; in measles, 152; for relief of diabetic neuralgia and neuritis, 766; for relief of headache in typhoid fever, 27; for relief of neuralgia complicating acute rheumatism, 304; for relief of pain in acute gout, 703; for relief of pain in acute polymyositis, 685; for re-

- lief of pain in Rocky Mountain fever, 564; for relief of pain in septicopyemia, 291; for relief of pain in small-pox, 47; in scarlet fever, 126; in varicella, 112; in Weil's disease, 572.
- Phenol**, local use of, to relieve itching in diabetes mellitus, 764; local use of, in Rocky Mountain fever, 565; objections to, as disinfectant for tuberculous sputum, 453; subcutaneous use of, in tetanus, 349.
- PHENOLPHTHALEIN**, use of, combined with rhubarb, in diabetes mellitus, 736.
- Phenolsulphonates**, the, use of, as antiseptics in intestinal autointoxication, 675.
- Phenyl salicylates**, use of, as an antiseptic in intestinal autointoxication, 675.
- PHILIP, DR. R. W.**, work by, on prevention of tuberculosis, 441.
- PHILIPPINES, THE**, history of vaccination in, 104.
- PHIPPS, JAMES**, first inoculation for small-pox performed upon, 58.
- PHLEBITIS**, as a complication of typhoid fever, 28.
- PHLORIDZIN**, glycosuria produced by injection of, 724.
- "Phosphorisme,"** 628.
- Phosphorus**, use of, in after-treatment for morphinism, 623; in rachitis, 817.
- PHOSPHORUS POISONING**, 626; acute form of, 627; chronic form of, 628; history of, 626; operative measures in treatment of chronic form, 630; prophylaxis against, 629; treatment of acute form of, 627; treatment of chronic form of, 630.
- PHYSICIAN**, duty of, in diabetes mellitus, 734, 737; as regards infection in measles, 139, 145; as regards infection in scarlet fever, 120; as regards infection in small-pox, 44.
- PHYSIOLOGY OF OBESITY**, 781.
- PHYTOLACCÆ DECANDRA**. *See* Pokeroor.
- Pilocarpin**, use of, in nephritis complicating scarlet fever, 133; in orchitis and epididymitis in mumps, 172; in pneumonia, 236; in tetanus, 350; in wood alcohol poisoning, 610.
- Pituitary extract**, use of, in diabetes insipidus, 778.
- Plasters, mercurial**. *See* Mercurial plasters.
- Plasters, mustard**. *See* Mustard.
- PLATT**, early inoculation with cow-pox for prevention of small-pox by, 57.
- PLEURAL EFFUSION**, accompanying tuberculosis, 507.
- PLEURISY WITH EFFUSION**, as a complication of pneumonia, 261.
- Pneumococci**, autolyzed, use of, in pneumonia, 243.
- PNEUMOCOCCUS**, history of, 220.
- PNEUMOCOCCUS MENINGITIS**, 210
- Pneumococcus serum**, use of, in meningitis complicating pneumonia, 259.
- Pneumococcus vaccine**, use of, in mixed infections, 243; in pneumonia, 240; results of, 241, 242.
- PNEUMONIA, LOBAR**, 217; abscess of lung complicating, 266; adrenalin in treatment of, 252; afebrile form of, 258; in alcoholics, 258; antipneumococcus serum in treatment of, 238; autolyzed pneumococci in treatment of, 243; bacteriology of, 217; bilious type of, 258; blood pressure in cardiac toxemias in, 254; bradycardia complicating, 260; bronchorrhea complicating, 261; care of the body in, 226; "carriers" of, 222; chemoimmunity in treatment of, 245; in childhood, 220; chill as an initial symptom, 226; cleanliness important in prophylaxis of, 223; as a complication of influenza, 191; as a complication of whooping-cough, 175; complications and sequelæ of, 257; convalescence from, 262; correction of predisposing conditions in prophylaxis of, 222; cough and expectoration as a symptom of, 225, 257; crisis in, 257; definition of, 217; delayed resolution in, 257; delirium as a symptom of, 228; diabetic type of, 258; diagnosis between, and typhoid fever, 39; diet in, 228; dilatation of the stomach complicating, 229; disinfection in, 222; division of cases in, 219; education of public a factor in prophylaxis of, 223; empyema complicating, 261; endocarditis complicating, 260; epidemic of, due to *B. pneumoniæ* in infected bacon, 643; examination of patient in, 221; gastrointestinal tract in, 227; irritating drugs in treatment of, to cause abscess, 246; isolation of cases in, 220; leukocytic extract in treatment of, 244; medicinal treatment of, 233; meningitis compli-

- cating, 259; metallic ferments in treatment of, 246; mortality from, 218; nephritis complicating, 259; nurse's duty in, 222; nutritive changes in, 228; in old age, 220; open-air treatment of, 224; operative treatment indicated in, 261; oral cleanliness important in prophylaxis of, 221; oxygen in treatment of, 236; pain in, 223; pericarditis complicating, 261; pleurisy with effusion complicating, 261; pneumococcus vaccine in the treatment of, 240; position of patient in, 225; prevention of second attack of, 222; prophylaxis in, 220; public health in regard to, 222; in public institutions, 221; pulmonary edema complicating, 259; recurrence of, 220; requisites of treatment for, 219; specific treatment of, 237; statistics of, 218; tachycardia complicating, 220; treatment of complications and sequelae of, 257; treatment of, in general, 223; treatment of sputum in, 221; venesection in treatment of, 225; veratrum in treatment of, 248.
- PNEUMONIA, AFEBRILE**, 258.
- PNEUMONIA, ASPIRATION**, danger of, in meat poisoning, 639.
- "Pneumonia bags,"** 232.
- PNEUMONIA, ETHER**, prevention of, 222.
- PNEUMONIA, SECONDARY**, prevention of, 222.
- PNEUMOTHORAX, ARTIFICIAL**, production of, in tuberculosis, 535; apparatus employed in, for injection of gas, 537; methods of production of, 535; method of injecting gas or air in, 537; selection of cases for, 536.
- PNEUMOTHORAX, accompanying tuberculosis**, 507.
- POCK DISEASES OF ANIMALS**, 54; ape-pox, 56; cow-pox, 56; groups of, 54; horse-pox, 55; sheep-pox, 55.
- POISON CUP**, 648.
- Poisoning by food**. See Food.
- POISONOUS FRUITS AND SEEDS**, 651.
- POISONOUS ROOTS**, 650.
- POKEROOT**, poisoning by, 650.
- POLYMYOSITIS, ACUTE**, 684; treatment of, 685.
- Polyvalent serum**, use of, in treatment of pneumonia, 240.
- PORK**, meat poisoning due to, 638.
- PORTUGAL**, introduction of vaccination into, 60.
- POSEN**, mortality from small-pox in, before and after vaccination, 95.
- POST-DIPHTHERITIC PARALYSIS**, 278.
- POST-TYPHOID PSYCHOSES**, as a complication of typhoid fever, 29.
- Potassium bromid**, use of, in acute alcoholism, 589.
- Potassium chlorate**, use of, as gargle, in foot and mouth disease, 583; in syphilitic angina, 426.
- Potassium iodid**, use of, in actinomyces, 360, in bronchitis complicating influenza, 189; in cerebrospinal meningitis, 213; in glandular enlargement accompanying rachitis, 818; in mumps, 170; in optic neuritis due to poisoning with wood alcohol, 610; in syphilis, 408.
- Potassium nitrate**, in pneumonia, 227.
- Potassium permanganate**, use of, for flushing the colon in intestinal auto-intoxication, 674; as a gargle in syphilitic angina, 426; injections of, in chancre with phimosi, 423; in local treatment of foot and mouth disease, 583; in local treatment of mucous patches, 427; for stomach washing in acute opium poisoning, 614; for stomach washing in meat poisoning, 639; for stomach washing in phosphorus poisoning, 627; for relief of throat symptoms in scarlet fever, 130; for relief of throat symptoms in small-pox, 47; in tertiary syphilitic lesions of mucous or mucocutaneous surfaces, 427.
- Potassium permanganate treatment**, of small-pox, 51.
- POTATO, COMMON**, poisoning by, 650.
- POUCHET, B. suiscepheus** described by, 642.
- Poultice, compound soap**, use of, in delayed resolution in pneumonia, 257.
- Poultice, flaxseed**, use of, in parotitis complicating typhoid fever, 27; in perforation in typhoid fever, 23; for relief of boils accompanying diabetes mellitus, 765; for relief of phlebitis complicating typhoid fever, 28.
- Poultices**, use of, in bacillary dysentery, 324; in bronchopneumonia complicating measles, 159.
- PREGNANCY**, diabetes in, 768; treatment of syphilis in, 431; vomiting of, associated with intestinal auto-intoxication, 683.

- PRESBYTERIAN HOSPITAL OF NEW YORK**, results in, attending the use of urotropin for prevention of pericarditis in pneumonia, 223.
- Priessnitz' applications**, employment of, in bronchopneumonia complicating measles, 159; in laryngeal complications of measles, 157; in laryngotracheal cough of measles, 152.
- PRISON FEVER.** See Typhus fever.
- Proteolysis**, use of, in septicopyemia, 290.
- PROPRIETARY FOODS**, long-continued use of, a cause of rickets, 817.
- PROSTATIC DISEASE**, as a complication of diabetes mellitus, 766.
- Protargol**, use of, in pellagra, 662; in small-pox for care of eyes, 50.
- PROTEIN**, sugar derived from, 725.
- PROTEINS**, function of, in body, 782.
- PRUDENTIAL INSURANCE COMPANY**, statistics concerning death from tuberculosis furnished by, 450.
- PRURITUS**, treatment of, in diabetes, 765; in varicella, 113.
- PRUSSIA**, introduction of vaccination into, 60.
- PSEUDO-RACHITIC OSTEOPOROSIS**, 813.
- PSEUDO-RICKETS**, 813.
- PSEUDOTRICHINOSIS.** See Polymyositis, acute.
- PSITTACOSIS**, 584; definition of, 584; diet in, 586; etiology of, 584; parrots in causation of, 584; prognosis in, 586; prophylaxis against, 584; treatment of, 586.
- PSORIASIS**, association of, with intestinal autointoxication, 683; as a complication of vaccination, 92.
- PSYCHASTHENIA**, associated with intestinal autointoxication, 682. See also Neurasthenia and Psychasthenia.
- Psychic influence**, in treatment of whooping-cough, 178.
- PROMAINS**, poisonous action of, 635.
- PTYALISM**, as a complication of mumps, 171.
- PUBLIC HEALTH**, relation of, to pneumonia, 222.
- Public prophylaxis against syphilis**, 374.
- PULMONARY EDEMA.** See Edema of the lungs.
- Puncture, deep**, use of, in muscular rheumatism, 689.
- Puncture, joint**, use of, in arthritis deformans and chronic rheumatism, 712.
- Puncture, lumbar**, in diagnosis of meningitis complicating influenza, 194; in diagnosis of meningitis complicating pneumonia, 259; technique of, 204; in treatment of cerebrospinal meningitis, 202.
- PURIN BODIES**, in causation of gout, 693.
- PURPURA**, as a complication of vaccination, 85.
- PYEMIA**, definition of term, 286.
- PYORRHEA ALVEOLARIS**, association of, with intestinal autointoxication, 679; danger of, in diabetes mellitus, 736.
- Pyramidon**, use of, in measles, 151; use of, to relieve pain in diabetic neuralgia or neuritis, 766.
- QUARANTINE**, period of, in diphtheria, 267; in foot and mouth disease, 582; in miliary fever, 579; in scarlet fever, 118, 121; in small-pox, 43.
- Quinin**, use of, in after-treatment of morphinism, 620; in bronchitis complicating influenza, 189; for control of cough in measles, 153; in convalescence from influenza, 196; in influenza, 187; in measles, 151; in miliary fever, 580; in nervous type of influenza, 191; in pneumonia, 233; in prophylaxis of influenza, 186; in Rocky Mountain fever, 565, 566; in scarlatinal arthritis, 305; in whooping-cough, 181; symptoms due to misuse of, in whooping-cough, 175.
- Quinin hydrochlorate**, use of, hypodermically in pneumonia, 234.
- Quinin hydrochlorid**, use of, in intestinal autointoxication in prevention of complications, 682.
- Quinin hydrochlorosulphate**, use of, hypodermically in pneumonia, 234.
- Quinin tannate**, use of, in enterocolitis complicating measles, 161; in measles, 151.
- Quinin and urea hydrochlorid**, use of, hypodermically in pneumonia, 233; method of administering, 234, 235.
- RABBITS**, use of, for small-pox virus, 67.
- RABIES.** See Hydrophobia.
- RACHITIS**, 812; blood changes in, 818; craniotabes in, 817; deficiency of calcium a cause of, 813; deformities occasioned by, 818; dietetic treatment of, 816; etiology of, 814; geographical distribution of, 812; glandular enlargement accompany-

- ing, 818; heredity in causation of, 815; history of, 812; intestinal disorders complicating, 818; medicinal treatment of, 817; muscular weakness accompanying, 818; nervous complications of, 819; pathogenesis of, 812; prophylaxis against, 815; respiratory disorders accompanying, 818; syphilis associated with, 814; treatment in early cases of, 817; treatment in florid form of, 817; treatment of, in general, 816.
- Radium therapy**, use of, in arthritis deformans and chronic rheumatism, 713.
- Rectal feeding**, in influenza with gastrointestinal symptoms, 190; in tetanus, 350; in whooping-cough, 180.
- Rectum**, administration of mercury by, in syphilis, 387; feeding by, *see* Rectal feeding.
- RECTUM, CHANCER OF.** *See* Chancre.
- Red light treatment**, of small-pox, 5.
- Reid's method**, of applying leeches in pneumonia, 257.
- REISS**, analysis by, of gastrointestinal symptoms in influenza, 189.
- REMLINGER**, on treatment for hydrophobia, 335.
- RENAL DERANGEMENT.** *See* Kidney.
- RENAULT**, work on small-pox organism by, 41.
- Resorcin**, irrigation of the bowel with a solution of, in the chronic stage of bacillary dysentery, 328.
- Resorcinol**, use of, to relieve itching in varicella, 112.
- RESPIRATORY TYPE OF INFLUENZA**, 188.
- Rest**, in treatment of acute rheumatism, 296; of bacillary dysentery, 324; of cardiac complications of acute rheumatism, 303; of chronic opium poisoning, 619; of "colds" during tuberculosis, 508; of convalescence from pneumonia, 262; of diphtheria, 275; of gangrenous or phagedenic chancre, 423; of Korsakow's psychosis, 609; of laryngeal complications in tuberculosis, 491; of muscarin poisoning, 648; of poisoning by *amanita phalloides*, 649; of pellagra, 662; of tuberculosis, 477; of tuberculosis during active stage, 479, 482; of tuberculosis during and after hemorrhage, 499, 501.
- Restraint**, method of applying in delirium tremens, 604.
- RETINITIS**, accompanying diabetes mellitus, 767.
- REVACCINATION AND ITS VALUE**, 75.
- RHEUMATISM, ACUTE**, 292; alkaline treatment of, 301; anemia complicating, 303; cardiac complications of, 302; causative agents in, 292; chorea complicating, 304; clothing of patient in, 297, 298; course of, 292; definition of, 292; development of, 292; diet in, 298; drugs in treatment of, 298; evidence of infectious nature of, 294; hygienic measures in prophylaxis of, 296; hyperpyretic cases of, 302; immobilization of joints in, 297, 306; indications for direct treatment of, 296; infectious nature of, 292; insomnia complicating, 302; meningitis complicating, 304; neuralgia complicating, 304; nurse's duty in, 296; organisms associated with, 293; portals of infection in, 292; prophylaxis in, 296; removal of adenoids as a prophylactic measure in, 296; removal of tonsils as a prophylactic measure in, 296; salicylates and similar drugs in treatment of, 299; serum therapy a failure in, 301; symptoms due to drugs administered in, 301; symptomatic treatment of, 302; synonyms for, 292; tonsils in relation to, 294; treatment of, 296; treatment of during convalescence, 301; vaccine therapy a failure in, 301.
- RHEUMATISM, CHRONIC, SO-CALLED**, 707; gonorrheal, *see* Arthritis, gonococcic; muscular, *see* Muscular rheumatism; scarlatinal, *see* Arthritis, acute scarlatinal; syphilitic, *see* Arthritis, syphilitic.
- RHODOBENDRON**, poisoning by, 652.
- Rhubarb**, use of, combined with phenolphthalein, in diabetes mellitus, 736.
- RICKETS.** *See* Rachitis.
- RICKETTS**, work by, on transmission of typhus fever, 32.
- RIGGS' DISEASE.** *See* Pyorrhea alveolaris.
- ROBERTS, SIR WILLIAM**, investigations by, on results of use of opium in India, 614.
- ROBIN, ALBERT**, results obtained by, in treatment of pneumonia by means of metallic ferments, 246.
- Robin's diet**, for reduction of obesity, 793.
- ROBINSON, DR. SAMUEL**, apparatus devised by, for injection of gas in pneumothorax, 536.

- Rochelle salts**, use of, in acute alcoholism, 589; in chronic alcoholism, 595.
- Rocky Mountain spotted fever**, 562; bronchitis complicating, 565; cerebrospinal symptoms in, 566; constipation in, 565; convalescence from, 567; diet in, 566; general and local treatment of, 564; geographical distribution of, 562; heart failure in, 565, 566; hydrotherapy for, 565; immunity produced by, 562; incubation period of, 564; introduction to subject of, 562; lung complications of, 565; nephritis complicating, 566; organism supposed to be cause of, 562; prophylaxis against, 563; serum therapy for, 567; summary of treatment for, 567; transmission of, 562.
- Rollleston**, use of thyroid extract in dipsomania suggested by, 601.
- Römer serum**, the, preparation and results of, in treatment of pneumonia, 239.
- Rosenow**, recent report by, on results of autolyzed pneumococci in treatment of pneumonia, 243.
- Rousnel law**, the, effect of, in prevention of tuberculosis in France, 442.
- Rubella**. *See* German measles.
- Rubella morbillosa**, 164.
- Rubella scarlatinosa**, 165.
- Rubidium iodid**, use of, in syphilis, 409.
- Russian empire**, mortality from small-pox in, before and after vaccination, 97.
- Saccharin**, as substitute for sugar in diabetes mellitus, 749.
- Saccharose**, presence of, in diabetic urine, 728.
- Sacco, Luigi**, early work in vaccination by, 58, 59.
- Salicin**, use of, in acute rheumatism, 300; in scarlet fever, 124.
- Salicylate of mercury**. *See* Mercury.
- Salicylates**, the, use of, in acute scarlatinal arthritis, 305; in arthritis deformans, 713; in diabetes mellitus, 760; to relieve pain in acute polymyositis, 685; in Rocky Mountain fever, 564.
- Salicylic acid**, local use of, in small-pox, 49; as spray for throat in scarlet fever, 129; in vaccinated arm, 73.
- Salicylic acid and related drugs**, use of, in acute rheumatism, 299; in measles, 151; disagreeable symptoms following, 301.
- Salicylic acid ointment**, for vaccinated arm, 73; in diabetic vulvitis, 765; in varicella, 113.
- Saline cathartics**. *See* Cathartics.
- Saline infusion**, use of, in pneumonia in connection with inhalations of oxygen, 237.
- Saline solution**, hot, use of, by vaginal douche in diabetic vulvitis, 765.
- Saline solution**, normal, intravenous injection of, *see* Injection, intravenous; rectal injection of, *see* Injection, rectal; subcutaneous injections of, *see* Injection, subcutaneous.
- Salipyrin**, use of, in acute rheumatism, 300; in acute scarlatinal arthritis, 305; in measles, 151; for relief of pain in acute polymyositis, 685.
- Salivation**, due to hydrargyrisms, 384.
- Salol**, use of, in acute rheumatism, 300; in glandular fever, 576; in diarrhea complicating septicemia, 291; in enterocolitis complicating measles, 161; in intestinal autointoxication, 675; in infantile diarrhea, 329; to relieve pain in Rocky Mountain fever, 564; in Weil's disease, 572.
- Salt-free diet**, use of, in scarlet fever as preventive of nephritis, 133.
- Salt-poor diet**, value of, in diabetes insipidus, 776.
- Salt rub**, use of, in pellagra, 662.
- Salvarsan**. *See* Arsenobenzol.
- Sambon**, theory of pellagra as a protozoal disease held by, 658.
- Sanatorium, Adirondack Cottage**. *See* Adirondack.
- Sanatorium treatment**, for alcoholism, 594; for morphinism, 617; for tuberculosis, 469; objections to, in reduction of obesity, 789, 809; objections to, in tuberculosis complicated with diabetes mellitus, 767.
- Sanguinaria**, tincture of, use of, to relieve cough during convalescence from pneumonia, 257.
- Saponin**, poisonous action of, 650, 651.
- Saxony**, history of vaccination in, 102.
- Scarenzio**, use of insoluble salts of mercury in treatment of syphilis advanced by, 390, 394.
- Scarlet fever**, 114; arthritis complicating, 132; cardiac weakness complicating, 127; cause of, 114; cerebral symptoms in, 127; cervical adenitis complicating, 131; diet

- in, 123; disinfection in, 120; dissemination of, 116; diuretics in, 125; drugs in prevention of, 123; febrifuges in, 125; gargles in, 125; gastrointestinal disorders complicating, 132; hydrotherapy in, 125; hygienic measures in, 123; inunctions in, 124; isolation in, 118; medical treatment of, 124; mode of entrance of germ of, 117; nervous symptoms in, 127; nephritis complicating, 132; nurse's duty as regards infection in, 119; operative measures in, 131, 132; otitis complicating, 130; period of greatest infection in, 117; persistence of virulence of, 116; prevention of, in hospitals, 121; prevention of, in schools, 122, 125; preventive drugs for, 123; preventive inoculation for, 123; preventive treatment for, 118; quarantine for, 118, 121; respiratory complications and sequelae, 134; "return cases of," 117; sepsis complicating, 128; serum treatment of, 128; sick room in, 118; sloughing of tonsils in, 130; source of germs in, 115; temperature in, 125; throat affections complicating, 129; treatment of attack, 123; treatment of complications and sequelae, 129; treatment of convalescence, 128.
- SCARLATINAL RHEUMATISM.** See Arthritis, acute scarlatinal.
- SCARS OF VACCINATION,** 74; value of, as sign of immunity, 98.
- SCHAEFFER,** epidemic of miliary fever reported by, 579.
- SCHAMBERG,** ointment recommended by, for itching in diabetes mellitus, 764.
- SCHAUDINN AND HOFFMANN,** discovery of the spirochete by, 362.
- SCHMIDT, ADOLPH,** test proposed by, for estimating the state of the intestinal tract in tuberculosis, 502; work by, on intestinal complications in tuberculosis, 557.
- SCHOOL CHILDREN,** protection of, against tuberculosis, 459.
- SCHOOLS,** duty of, to teach injurious effects of alcohol, 592; establishment of, for tuberculous children, 460; prevention of measles in, 144; prevention of scarlet fever in, 122; prevention of tuberculosis in, 453.
- SCHOTT GYMNASIUM EXERCISES,** 641.
- Schwenger system,** the, reduction of obesity by, 793.
- SCIATIC PAIN,** as symptom of diabetes mellitus, 766.
- SELAVO,** antianthrax serum introduced by, 331; results of serum on mortality of anthrax reported by, 332.
- Scopolamin,** use of, in delirium tremens, 606.
- SCOTLAND,** antituberculosis work in, 440.
- Sea bathing,** value of, in diabetes mellitus, 762; in rachitis, 816.
- Sea voyages,** value of, in treatment of tuberculosis, 473.
- SECONDARY CUTANEOUS SYMPTOMS OF SYPHILIS.** See Syphilis.
- SECONDARY PNEUMONIA.** See Pneumonia.
- Secretin,** use of, in diabetes mellitus, 761.
- SEDENTARY LIFE,** relation of, to obesity, 785.
- Seigert's rule,** in prophylaxis of measles, 144.
- Seller's solution,** use of, as mouth wash in mumps, 170.
- SELM,** separation of poisonous alkaloids from food first effected by, 634.
- SEPSIN,** as a cause of food poisoning, 635.
- SEPSIS,** as a complication of scarlet fever, 128.
- SEPTICEMIA,** as a complication of vaccination, 91; definition of term, 286.
- SEPTICOPYEMIA,** 286; definition of, 286; diagnosis of, 288; diet in, 290; etiology of, 287; gastric irritability in, 291; organisms causing, 287; pathology of, 287; prognosis of, 288; prophylaxis of, 289; specific treatment of, 289; surgical treatment of, 289; symptoms of, 287; symptomatic treatment of, 290; treatment of, in general, 289.
- Sera, antityphoid,** 7.
- Sera, immune,** antianthrax, 331; antidiphtheritic, 269; antiinfluenzal, 194, 210; antimeningitic, 200; antipneumococcic, 238; antirabic, 339; antistreptococcic, 128, 155; antitoxic, 183, 639; antityphoid, 7; Moser's, 129; polyvalent, 240; Römer's, 239.
- Serum therapy,** use of, in acute rheumatism, 301; in anthrax, 331; in bacillary dysentery, 321; in cerebrospinal meningitis, 200; in erysipelas, 284; in glanders, 358; in influenza, 186; in influenzal meningitis, 210; in pneumonia, 238; in pneumococcus meningitis, 210; in Rocky Mountain fever, 567; in scarlet fever, 128; in septi-

- copyemia, 290; in small-pox, 52; in staphylococcus meningitis, 211; in streptococcus meningitis, 210; in syphilis, 437; in tuberculosis, 525; in tuberculous meningitis, 209.
- Serum therapy in epidemic cerebrospinal meningitis**, 200; in chronic cases, 209; frequency of administration of, 206; indications for use of, 204; use of, in protracted cases, 207; use of, in relapses, 207; use of, in resistant cases, 208; size of dose in, 205; technique of administration of, 205.
- SEXUAL ORGANS**, relation between secretion of, and body weight, 786.
- SHEEP-POX**, 55.
- SHELL-FISH**, poisoning by, 645.
- SHIGA**, determination by, of causal agent in epidemic dysentery, 316; preparation by, of immune serum for use in epidemic dysentery, 321.
- SHIGA BACILLUS**, THE, 317.
- SHIP FEVER**. *See* Typhus fever.
- SIEBER-SCHOUMOW**, B. piscicidus agilis isolated by, from fish, 644.
- "**SIGUATERA**," 633.
- Silver nitrate**, local use of, in chronic stage of bacillary dysentery as application to bowel wall, 327; in diabetic vulvitis, 765; in foot and mouth disease, 583; in mucous patches, 427; in pharyngeal cough of tuberculosis, 495; results of, in treatment of bite by rabid animal, 336; in stomatitis due to hydrargyrisim, 385; in syphilitic onychia, 429; in tertiary syphilitic lesions of mucous and mucocutaneous surfaces, 427; in throat affections complicating scarlet fever, 130; for ulceration of cornea in small-pox, 50.
- Silver nitrate**, use of, as irrigation in tuberculosis of intestines, 505; as rectal injection in acute stage of bacillary dysentery, 327.
- Simaruba**, use of, in bacillary dysentery, 327.
- SIMULIUM REPTANS**, as cause of pellagra, 658.
- SITOTOXISMUS**, 652.
- "**606**". *See* Arsenobenzol.
- SKIN**, administration of mercury by, in syphilis, 387.
- SKIN**, DISTURBANCE of, due to use of arsenobenzol in syphilis, 415; as a complication of diphtheria, 279; due to hydrargyrisim, 384; in varicella, 112.
- SLEEP**, methods of securing, in delirium tremens, 607.
- SLEEPLESSNESS**. *See* Insomnia.
- SMALL-POX**, 40; control of itching in, 49; definition of, 40; delirium in, 48; diet in, 46; disposal of dead in, 45; edema of glottis complicating, 51; eruption in, 48; erysipelas complicating, 49; eyes and their care in, 50; history of, 40; immunity from, 410; incubation period of, 43; infective period in, 41; inflammation of larynx complicating, 51; inflammation of tongue complicating, 51; inoculation for, 52; insomnia in, 48; organism causing, 41; pain as a symptom of, 47; physicians' duty in, 44; potassium permanganate treatment of, 51; prophylaxis in, 43; quarantine in, 43; red light treatment of, 51; serum treatment of, 52; suppuration in, 48; susceptibility to, 40; temperature in, 47; throat disturbances in, 47; tracheotomy in, 51; transmission of, 42; treatment of, 45; vaccination for, 43, 45. *See also* Vaccination.
- SMALL-POX HOSPITAL**, 43.
- SMALL-POX VIRUS**, diluents for, 65; preparation of, 62, 63; preservation of, 65; use of rabbit for, 67.
- SMITH**, EUSTACE, mouth wash for use in mumps suggested by, 171.
- SMITH**, DR. JAMES, experiments by, on inoculation for small-pox, 92.
- SMITH**, NATHAN, early employment of hydrotherapy in general infections by, 16; on fan bath in typhoid fever, 18.
- Soamin**, use of, in pellagra, 660.
- SOCIAL CUSTOMS**, influence of, in causation of alcoholism, 590.
- Soda**, washing, external use of, for itching in diabetes mellitus, 764.
- Soda benzoate**, use of, in the asthenic form of measles, 153.
- Sodium arsenate**, use of, in preventive treatment of boils in diabetes mellitus, 765.
- Sodium bicarbonate**, internal use of, in acidosis during diabetes mellitus, 756, 770; in acute alcoholism, combined with nux vomica, 589; in acute rheumatism together with other remedies, 299, 301; in diabetic coma, 757; in pneumonia,

- 234; in pneumonia, combined with calomel, 227; in stomach washing for acute alcoholism, 589; in treatment of morphinism, 624.
- Sodium bicarbonate**, intravenous injection of, in a diabetic patient under influence of a general anesthesia, 770.
- Sodium bicarbonate**, local use of, for disinfection of mouth, in measles, 148; in small-pox, 47.
- Sodium borate**, use of, in treatment of obesity, 809.
- Sodium bromid**, use of, for relief of laryngismus stridulus in rachitis, 820.
- Sodium cacodylate**, use of, in pellagra, 660.
- Sodium chlorid**, use of, as test in diabetes insipidus, 774; in pellagra, 659.
- Sodium citrate**, use of, in acidosis during diabetes mellitus, 756; in acute rheumatism, 301; for control of vomiting in whooping-cough, 180; in diabetic coma, 757.
- Sodium iodid**, use of, in arthritis deformans and chronic rheumatism, 714; in glandular enlargement accompanying rachitis, 818; in syphilis, 409.
- Sodium nitrate**, use of, in control of hemorrhage from pulmonary tuberculosis, 500.
- Sodium phosphate**, use of, in influenza, 187; in intestinal autointoxication, 672; in prevention of boils accompanying diabetes mellitus, 765; in Weil's disease, 572.
- Sodium salicylate**, use of, in acute rheumatism, by the rectum, 300; in asthenic form of measles, 153; in influenza, 187; in Weil's disease, 572.
- Soja**, use of, in diabetes mellitus, 747.
- SOLLIER, PAUL**, on suffering following treatment for morphinism, 625.
- SORE ARM AND ULCERATION**, as a complication of vaccination, 86.
- Spa treatment**, in diabetes mellitus, 763; in gout, 701; in obesity, 809.
- SPAIN**, introduction of vaccination into, 60.
- Sparteïn**, use of, in nephritis complicating scarlet fever, 134; in pneumonia with cardiac toxemia, 254; in treatment of morphinism, 623.
- SPASMOPHILIA**, relation of, to rachitis, 819.
- SPECIFIC SERUM REACTION OF SYPHILIS**, discovery of, 362.
- SPINAL CURVATURE**, association of, with rickets, 816, 818.
- Spiritus etheris compositus**. *See* Compound spirits of ether.
- SPIROCHETE**, discovery of, 362.
- SPONDYLITIS**, 710.
- Spraying of nose and throat**, in diphtheria, 272; in laryngeal tuberculosis, 492; limited value of, in whooping-cough, 181; in measles, 156; for relief of "colds" accompanying tuberculosis, 508.
- SPURIOUS VACCINATION**, as complication of vaccination, 80.
- SPUTUM**, treatment of, in pneumonia, 221; in tuberculosis, 453, 466, 498; in whooping-cough, 186, 187.
- STAPHYLOCOCCUS MENINGITIS**, 211.
- Starvation**, employment of, in bacillary dysentery, acute stage, 325; in chronic stage, 328.
- STATIC AILMENTS**, 709.
- STEAM**, use of, as disinfectant for tuberculosis, 153.
- STENOSIS OF LARYNX**, due to laryngeal tuberculosis, 494.
- STEVENSON, SIR THOMAS**, epidemic of malignant edema due to *B. proteus vulgaris* infecting sardines described by, 644.
- STILL'S DISEASE**, 710.
- Stimulants**, use of, in cerebrospinal meningitis, 214; in measles before giving cold bath, 149; objections to, in hemorrhage during pulmonary tuberculosis, 501.
- Stimulants, alcoholic**, use of, in cerebrospinal meningitis, 214; in pneumonia with cardiac toxemia, 254.
- Stimulants, cardiac**, use of, in muscarin poisoning, 648; in pulmonary edema complicating pneumonia, 259.
- Stimulants, diffusible**, use of, in pneumonia of alcoholics, 258; in pneumonia with cardiac toxemia, 254.
- Stimulants, ethereal**, use of, in crisis of pneumonia, 257.
- STOLTZNER**, hypothesis advanced by, as to causation of rickets, 814; investigation by, on relation between rickets and suprarenal glands, 813.
- "STOMACH COUGH,"** 495.
- Stomach pump**. *See* Stomach tube.
- Stomach tube**, administration of food by, in meat poisoning, 639; evacuation of stomach by, in acute opium poisoning,

- 614; evacuation of stomach by, in acute phosphorus poisoning, 627; evacuation of stomach by, in meat poisoning, 639, 641.
- STOMACH WASHING.** *See* Lavage.
- STOMATITIS APHTHOZA**, as a complication of measles, 157.
- STOMATITIS GANGRENOZA**, as a complication of measles, 157.
- STOMATITIS, MERCURIAL.** *See* Mercurial stomatitis.
- STOMATITIS ULCEROSA**, as a complication of measles, 157.
- Strapping the chest**, as a means of relieving pain accompanying tuberculosis, 506.
- Strapping the side**, for relief of pain in pneumonia, 227.
- STRASSBURGER**, on the significance of retarded bowel action in intestinal auto-intoxication, 671.
- STREPTOCOCCUS MENINGITIS**, 210.
- STREPTOCOCCUS SCARLATINÆ**, 114.
- Streptococcus serum**, use of, in typhus fever, 37.
- Strontium bromid.** *See* Bromid of strontium.
- Strophanthus**, use of, in cardiac failure complicating influenza, 193; in cerebrospinal meningitis, 214; in diphtheria, 277; in pneumonia with cardiac toxemia, 252.
- Strychnin**, use of, for acute alcoholism, combined with apomorphin, 589; in acute alcoholism, combined with capsicum, 589; in acute alcoholism, hypodermically, 589; in acute opium poisoning, 615; in acute rheumatism, 300; in bacillary dysentery, for collapse in acute stage, 327; in barbel cholera, 644; in bronchopneumonia complicating influenza, 192; in cardiac failure complicating influenza, 193; in cerebrospinal meningitis, 214; in cervical adenitis complicating scarlet fever, 131; in cheese poisoning, 647; in chronic alcoholism, combined with atropin, 595; in chronic opium poisoning, 620, 623; in convalescence from scarlet fever, 128; in convalescence from small-pox, 47; in delirium tremens, 604; in delirium tremens, combined with digitalin, 606, 607; in delirium tremens, combined with digitalis, 606, 607; in diabetes insipidus, 777; in diphtheria, 277; in meat poisoning, combined with digitalis, 640; in nervous type of influenza, 191; in pneumonia with cardiac toxemia, 251; in poisoning by amanita phalloides, 649; in post-diphtheritic paralysis, 278; to raise blood pressure, 255; in Rocky Mountain fever, as a heart stimulant, 565, 566; in scarlet fever with cardiac weakness, 127; in septicemia, 291; in tuberculosis, to relieve dyspnea, 506; in tuberculosis, as a tonic, 504; in typhoid fever, 47; in wood alcohol poisoning, 610.
- SUBCUTANEOUS INJECTION.** *See* Injection.
- SUGAR, MILK.** *See* Lactose.
- SUGAR**, sources of, in body, 725; substitutes for, in diabetes mellitus, 749.
- Suggestion, hypnotic.** *See* Hypnotic suggestion.
- SUICIDE**, danger of, in acute hallucinosis of drunkards, 608; phosphorus taken for the purpose of, 626.
- Sulphonah**, use of, in after-treatment of morphinism, 624; in cerebrospinal meningitis, 214; in delirium tremens, 606, 607.
- Sulphonethyl methane**, use of, in nervous type of influenza, 191.
- Suppositories**, administration of calomel by, in chancre of the rectum, 424; administration of mercury by, in syphilis, 387; administration of opium by, in bacillary dysentery, 327.
- SUPRARENAL GLANDS**, relation between secretion of, and rickets, 813.
- SURGICAL OPERATIONS**, danger of, in diabetic patients, 769.
- Suspensory**, use of, for pruritus of the scrotum in diabetes mellitus, 765.
- SUTTON AND FEWSTER**, inoculation of immune individual with small-pox by, 57.
- SWEATING**, in miliary fever, 578.
- SWEDEN**, introduction of vaccination into, 60; mortality from small-pox in, before and after vaccination, 94, 106.
- SWEEPING AND DUSTING**, rules for, in tuberculosis, 467.
- SWITZERLAND**, introduction of vaccination into, 60.
- SYPHILIDS, PALMAR AND PLANTAR**, local treatment of, 429.
- SYPHILIS**, 361; abortive treatment of, 376; administration of mercury by mouth in, 385; alcohol in, 369; arsenic in treatment of, 411; arsenobenzol in treatment of,

- 412; atoxyl in treatment of, 412; auxiliary medication in, 435; classifications of patients in, 366; as a complication of vaccination, 87; constitutional treatment of, 416; contagiousness of lesions in, 371; contagiousness of normal secretions in, 371; continuous mercurial treatment of, 417; continuous intermittent treatment for, 418; cutaneous administration of mercury in, 387; diabetes associated with, 768; divisions of treatment for, 363; educational prophylaxis against, 375; factors predisposing to infection from, 370; hygienic measures in, 364; influence of other maladies upon, 370; injection method of administering mercury in, 390; intermittent mercurial treatment for, 417; inunction method of administering mercury in, 387; iodids in treatment of, 404; local treatment of lesions in, 421; marital prophylaxis against, 376; mercurial baths in treatment of, 389, 433; mercury in cure of, *see* Mercury; nervous hygiene in, 366; opotherapy in, 436; oral hygiene in, 368; physical hygiene in, 365; prophylaxis against, in general, 370; public prophylaxis against, 374; question of cure in, 420; rachitis associated with, 814; rectal administration of mercury for, 387; registration and examination as a means of prophylaxis against, 375; secondary cutaneous symptoms of, 425; serum therapy for, 436; specific medication for, 380; tobacco injurious in, 369; tonics in treatment of, 435; treatment in hereditary form of, 432; treatment of, in pregnancy, 431; treatment of secondary cutaneous symptoms of, 425; treatment of tertiary cutaneous symptoms, 426; vaccination for small-pox a means of transmitting, 87, 372; vaccine therapy for, 437; Wassermann's reaction as test for, 379, 420.
- SYPHILIS, HEREDITARY**, treatment of, 432; arsenobenzol in, 433; hygienic measures in, 433; injections unsuitable in, 433; inunctions best suited for, 434; iodids in, 434; mercury in, 433; mixed treatment in, 434.
- SYPHILIS, HYGIENE OF**, 364; alcohol injurious to, 369; importance of, 364; influence of other diseases, local and general, upon, 370; mouth hygiene in, 368; nervous hygiene in, 366; physical hygiene in, 365; sexual hygiene in, 368; tobacco injurious to, 369.
- SYPHILIS OF THE MUSCLES.** *See* Muscles.
- SYPHILITIC ARTHRITIS**, 306.
- SYPHILITIC HYPERTROPHIC PAPULE**, local treatment of, 428.
- SYPHILITIC LESIONS**, local treatment of, 421; of chancre, 422; of secondary cutaneous symptoms, 425; of secondary mucous symptoms, 426; of special secondary and tertiary lesions, 427; of tertiary cutaneous symptoms, 426; of tertiary mucous symptoms, 427.
- SYPHILITIC RHEUMATISM.** *See* Syphilitic arthritis.
- SYPHILITIC TUBERCLE**, local treatment of, 428.
- SYPHILODERMS**, local treatment of, 425.
- Syringe, hypodermic**, for use in intramuscular injection of mercury in syphilis, 399.
- Syzygium Jambulanum**, use of, in diabetes mellitus, 760.
- TACHYCARDIA**, as a complication of pneumonia, 260.
- Tannic acid**, use of, as gargle in measles, 148; irrigation of bowels with solution of, in bacillary dysentery, 327.
- Tannin**, as an antidote to muscarin poisoning, 648; use of, in ergotism, 652; use of, to neutralize morphin in the stomach, 615.
- TARDIEU**, poisoning from match heads reported by, 627.
- TAYLOR, A. E.**, on autointoxication due to gastrointestinal infection, 664.
- Tea, strong green**, use of, in acute opium poisoning, 615.
- TEETH**, care of, a factor in prevention of acute rheumatism, 296; a necessity in cure of tuberculosis, 490.
- TEMULIN**, poisonous action of, 651.
- TENDER TOES**, in typhoid fever, 29.
- TENESMUS**, treatment of, in bacillary dysentery, 327.
- Terebene**, use of, in treatment of bronchorrhea complicating pneumonia, 261; for relief of gangrene of the lung complicating pneumonia, 261.

- TETANUS**, 344; antitoxin in treatment of, 344; Bacelli's method of treating, 349; cases of, treated with antitoxin and chloretone, 354; cases of, treated with antitoxin, and sedatives, 351; cases of, treated with subdural injection of magnesium sulphate, 348, 349; as a complication of vaccination for small-pox, 90; danger of, from use of gelatin for control of hemorrhage, 155; dose of antitoxin for, 346, 347; drugs in treatment for, 347; feeding in, 350; general measures of treatment for, 350; method of injecting antitoxin for, 345; mortality from, 350; nursing in, 350; prevention of, 347, 350; results of antitoxin treatment for, 350; rules for use of antitoxin, 350; single and multiple injections of antitoxin, 346; symptomatic treatment of, 349; treatment of actual cases of, 351; treatment of infected area, 347.
- Tetanus antitoxin**, 344; curative dose of, 346; method of injecting, 345; mortality affected by, 350; preventive dose of, 347; single or multiple injections of, 346; use of, 344.
- TETANY**, as complication of rachitis, 819.
- Theocin**, use of, in diabetes insipidus, 777; in nephritis complicating scarlet fever, 134.
- Thoracotomy**, performance of, for relief of empyema accompanying tuberculosis, 507.
- THROAT AFFECTIONS**, as a complication of scarlet fever, 129.
- Thymol**, internal use of, as an antiseptic in intestinal autointoxication; 675.
- Thymol**, local use of, for irrigating the bowels in chronic stage of bacillary dysentery, 327; for relief of itching complicating diabetes mellitus, 764; as a spray for the throat in scarlet fever, 129.
- THYMUS GLAND**, supposed relation between disturbance of, and rachitis, 813.
- Thymus gland**, extract of, in treatment of arthritis deformans and chronic rheumatism, 713.
- THYROID GLAND**, influence of, on diabetes mellitus, 767; supposed relation between disturbance of, and rachitis, 813.
- THYROID INSUFFICIENCY**, as a cause of dipsomania, 601.
- Thyroid therapy**, use of, in arthritis deformans and chronic rheumatism, 713; in dipsomania, 601; in reduction of obesity, 786, 809.
- TINEA TONSURANS**, as complication of vaccination, 85.
- Tissue irrigation**. *See* Irrigation.
- TOBACCO SMOKING**, as a cause of cough in pulmonary tuberculosis, 496; influence of, in causation of gout, 698; injurious effects of, in syphilis, 369; use of, prohibited in chancre of lips, mouth, or tongue, 425.
- Tokay wine**, use of, in pneumonia with severe asthenia, 254.
- TONGUE**, inflammation of, as complication of small-pox, 51.
- Tonics**, use of, after Lambert's treatment for alcoholism, 599; in syphilis, 435.
- TONSILS**, care of, in pneumonia, 222; relation between, and acute rheumatism, 294.
- TONSILS, REMOVAL OF DISEASED**, as a factor in the prevention of acute rheumatism, 296.
- TONSILS, SLOUGHING OF**, as a complication of scarlet fever, 130.
- TORRINGTON, CONN.**, results of antityphoid inoculation in, 5.
- TOUSSAINT**, report by, on immunization in anthrax, 331.
- Town's specific treatment**, for cure of alcoholism, 597; for cure of morphinism, 621.
- TOXALBUMINS**, obtained from diphtheria antitoxin, 635.
- TOXIC SUBSTANCES**, produced in physiological process of digestion, 632.
- TOXINS**, as a cause of food poisoning, 635; difficulty in destroying, 636.
- TRACHEOTOMY**, performance of, in diphtheria, 279; in edema of the glottis complicating small-pox, 51; in laryngeal complications of measles, 158; in laryngeal tuberculosis, 494; in laryngismus stridulus, complicating rachitis, 820; in mumps, 171; technique of, 279.
- TRICHINA SPIRALIS**, poisoning from, in food, 634.
- TRIMETHYLAMIN**, as a cause of food poisoning, 635.
- Trional**, use of, in cerebrospinal irritation, 214; in delirium of pneumonia, 228; in delirium tremens, 606; for relief of

- pneumonia during influenza, 192; for relief of insomnia during the Pasteur treatment for rabies, 339; for relief of insomnia in septicopyemia, 291.
- TROUSSEAU'S SIGN**, presence of, in rachitis, 819.
- TRUDEAU**, opinion expressed by, on results of tuberculin therapy, 524; statistics by, showing effect of tuberculin therapy on length of life, 523.
- Trypsogen**, use of, in diabetes mellitus, 762.
- Tuberculin, new**, 512.
- Tuberculin, old**, 512.
- Tuberculin therapy**, 510; dosage in, 520; duration of, 522; effects of, 523; final dose in, 522; history of, 510; method of administering dose in, 517; method of diluting dose in, 513; mortality influenced by, 523; use of, 523; reaction from tuberculin injection, 522; records of results obtained by, 524; selection of patients for use of, 516; site for injection in, 518; theory of action in, 511; varieties of tuberculin employed in, 511.
- TUBERCULOSIS**, 438; abscesses complicating, 509; absolute rest in treatment of, 482; advice to discharged patients, 559; alcohol in diet of, 558; alcohol in night sweats of, 505; alcohol as tonic in, 504; amusements in treatment of, 488; anemia in, 507; anorexia in, 504; antacid diet in, 557; anticonstipation diet in, 555; antituberculosis societies and their work, 451; antituberculosis work in different countries, 440; artificial pneumothorax in treatment of, 535; autoinoculation in, 525; bronchitis accompanying, 507; care of teeth in, 490; climate in treatment of, 472; clothing in, 489; as a complication of vaccination for smallpox, 90; concentrated diet in, 556; constipation accompanying, 504; cough in, 495; diabetes associated with, 767; diarrhea accompanying, 505; diet in acute, advanced, and complicated cases of, 551; diet during acute stage of, 481; diet for ambulant cases, 538; diet during gastrointestinal disturbances in, 502; diet in general in, 478, 538; diet in intestinal form of, 505; disinfection in, 452; drug treatment of, 509; dyspnea accompanying, 506; empyema accompanying, 507; examination of stools in, 503; exercise in treatment of, 477, 527; expectoration in, 498; fistulae complicating, 509; food requirements in, 539; gastrointestinal disturbances accompanying, 502; hemorrhage accompanying, 499; hemorrhage in relation to exercise in, 529; history of work against, 438; house infection in, 451; hypochlorhydria accompanying, 556; individual prophylaxis against, 455; insomnia accompanying, 506; intestinal form of, 505; laryngeal complications in, 490; liquid diet in, 555; marriage as a question in, 464; menstrual disturbances in, 507; menus for meals in, 552; night sweats in, 505; number and arrangement of meals in, 546; nursing of importance in active stage of, 482; open air in treatment of, 479; otitis media complicating, 509; pain in chest accompanying, 506; pleural effusion accompanying, 507; pneumothorax accompanying, 507; precautions to be observed in presence of, 465; preparation of food in, 544; prophylaxis against, in general, 438, 451; protection of child against, 458; protection of infant against, 456; protection of youth against, 462; rest in treatment of, 477, 482; routine in treatment of, 487; sanatorium treatment for, 477; selection of cases for sanatorium treatment in, 469; selection of cases for tuberculin therapy, 516; semi-liquid diet in, 554; serum therapy in, 525; sources of food supply in, 543; symptomatic treatment of, 494; system of graduated exercise for use in, 529; temperature during active stage of, 479, 483; temperature as a guide to effect of graduated exercise in, 528; test diet in, 502; treatment of, in general, 468; tuberculin therapy in, 510; "two-hour diet" for advanced cases of, 552; vaccine therapy for control of hemorrhage in, 499; variety of diet essential in, 546.
- TUBERCULOSIS IN ANIMALS**, laws controlling, in Denmark, 442.
- TUBERCULOUS MENINGITIS**, 209.
- TUBERCULOUS MYOSITIS**. *See* Myositis.
- Turkish bath**. *See* Bath.
- Turpentine, oil of**, use of, in acute phosphorus poisoning, 628.

- Turpentine**, use of, for control of hemorrhage in hemorrhagic measles, 155; in scarlet fever for prevention of nephritis, 133; in typhoid fever, 26.
- Turpentine stupes**, use of, in typhoid fever, 26.
- TYPHOID CARRIERS**, antityphoid vaccination of, 6; number of, 2; treatment of, 9.
- TYPHOID FEVER**, 1; alcohol in treatment of, 14, 23; carriers of, 2, 6, 9; circulatory disturbances in, 23; diagnosis between and typhus fever, 38; diarrhea as a symptom of, 25; diet in, 11; disinfection of excreta in, 7; epistaxis as a symptom of, 27; eruption in, 38; furunculosis complicating, 29; gall-bladder affections complicating, 28; gastric irritability complicating, 25; general care of, 9; genitourinary disturbances complicating, 24; headache as a symptom of, 27; hemorrhage complicating, 19; hydrotherapy for, 16; insomnia complicating, 26; lung affections complicating, 24; management of bowels in, 25; mastitis complicating, 28; meteorism complicating, 26; milk contaminated by infected water a cause of, 646; mortality in, 15, 19, 23; operative measures in, 21; otitis complicating, 28; oysters contaminated by sewage a cause of, 645; parotitis complicating, 27; perforation of intestines complicating, 22; periostitis complicating, 27; phlebitis complicating, 28; post-typhoid psychosis, as a sequel to, 29; prevention of extension of, 7; prophylaxis against, in general, 1; respiratory disturbances complicating, 24; septic eruption in, mistaken for typhus fever, 39; serum therapy for, 7; tender toes as a sequel to, 29; treatment of convalescence from, 29; treatment of, in general, 9; typhoid spine as a sequel to, 29; vaccination for, 3; vehicles for transmission of, 1.
- TYPHOID SPINE**, 29.
- TYPHUS FEVER**, 31; convalescent serum used in treatment of, 37; definition of, 31; diet in, 37; diagnosis between, and typhoid fever, 38; eruption in, 33; history of, 31; incubation period in, 33; mortality from, 37; symptoms of, 33; transmission of, 32; treatment of, 36.
- TYROTOXICON**, as a cause of food poisoning, 635; milk poisoning due to, 647.
- TYROTOXISMUS**. *See* Cheese poisoning.
- UNITED STATES**, antituberculosis work in, 443.
- U. S. ARMY**, results of antityphoid inoculation in, 4.
- UNIVERSAL CONGENITAL ASTHENIA**, 709.
- Uranium nitrate**, use of, in diabetes mellitus, 760.
- Urethan**, use of, in tetanus, 348.
- URINE**, characteristics of, in diabetes mellitus, 727; method of determining concentration of, 775; method of disinfecting in typhoid fever, 7; necessity for frequent examination of, in diabetes mellitus, 731; necessity for examination of, after German measles, 165; necessity for frequent examination of, in pneumonia, 227; typhoid fever transmitted by, 7, 24.
- Urotropin**, use of, in cerebrospinal meningitis, 213; in chronic gout, 704; in intestinal autointoxication as an antiseptic, 675; in meningitis complicating influenza, 194; in meningitis complicating pneumonia, 259; in pneumonia as a means of preventing complications, 223; in prophylaxis of influenza, 186; in scarlet fever, for prevention of nephritis, 133; in typhoid fever, 25; in whooping-cough, 181.
- URTICARIA**, as a complication of vaccination, 84.
- UTERINE NECK, CHANCER OF**. *See* Chancre.
- UVULA**, swelling of, in mumps, 171.
- VACCINAL LICHEN**, as complication of vaccination, 84.
- VACCINAL MILIARIA**, as complication of vaccination, 84.
- Vaccination for bacillary dysentery**, 322.
- Vaccination for small-pox**, 54; accidents complicating, 78; antivaccination agitation, 104; ape-pox, 56; Blue Book on, 59; choice of instruments for, 68; clinical history of, 70; complications due to vaccine virus, 80; complications of, 78; constitutional complications, 87; contraindications to, 73; cow-pox, 56; definition of, 54; diluents for virus, 65; discovery of, by Jenner, 58; drug erup-

tions mistaken for, 92; eczema complicating, 91; erysipelas complicating, 85; erythema complicating, 85; furunculosis complicating, 86; gangrene of pock, 87; generalized gangrenous vaccinia complicating, 83; generalized hemorrhagic vaccinia complicating, 82; generalized vaccine erythema complicating, 83; generalized vaccinia complicating, 80; generalized vaccinia from autoinfection complicating, 82; German vaccination law and its results, 100; hemorrhage into pock, 87; history of, 57; history of, in Cuba, 103; history of, in France, 60; history of, in Japan, 102; history of, in the Philippines, 104; history of, in Saxony, 102; horse-pox, 55; immunity conferred by, 77; impetigo contagiosa complicating, 86; indications for, 73; influence of, on exanthemata, 74; infected vesicles and their treatment, 72; insusceptibility to, 77; introduction of, into America, 61; introduction of, into European countries, 59; leprosy transmitted by, 90; lupus complicating, 90; mortality from small-pox before discovery of, 54, 94; mortality from small-pox since discovery of, 94; Neapolitan method of, 60; pemphigus complicating, 91; pock diseases of animals, 54; preparation of vaccine virus for, 62; protection afforded by, 94; protection of vaccine vesicle, 69; after psoriasis complicating, 92; purpura complicating, 85; rabbit virus used in, 67; revaccination and the value of, 75; ruptured vesicles and their treatment, 72; scars caused by, 74; septicemia complicating, 91; sheep-pox and, 55; skin affections complicating, 87; sore arm complicating, 86; spurious vaccination, 80; summary of subject, 106; syphilis transmitted by, 87, 372; technique of, 67; tetanus transmitted by, 90; tinea tonsurans complicating, 85; tuberculosis transmitted by, 90; urticaria complicating, 84; vaccinal lichen complicating, 84; vaccinal miliaria complicating, 84; value of, 92; whooping-cough in relation to, 74, 179.

Vaccination for syphilis, 437.

Vaccination for typhoid fever, 3.

VACCINE ERYTHEMA, GENERALIZED, as a complication of vaccination, 83.

Vaccine therapy, use of, in acute rheumatism, 301; in anthrax, 331; in bronchitis complicating tuberculosis, 508; in cerebrospinal meningitis, 210; to control expectoration in pulmonary tuberculosis, 499; in diabetes mellitus for relief of boils, 765; in erysipelas, 284; in glanders, 358; in influenza, 189; in pneumonia, 240; to relieve expectoration due to mixed infection in tuberculosis, 199; in septicopyemia, 290.

Vaccines, autogenous, use of, in furunculosis complicating typhoid fever, 29.

Vaccines, bacterial, recovery following administration of, in glanders, 358.

VACCINIA, GENERALIZED, as a complication of vaccination, 80; from autoinoculation, as a complication of vaccination, 82; gangrenous, as a complication of vaccination, 83; hemorrhagic, as a complication of vaccination, 82.

VAGINA, CHANCER OF. See Chancre.

VALENTIN AND DESOTEX, first work on vaccination in France done by, 60.

Valerian, use of, in diabetes insipidus, 777; in pneumonia with cardiac toxemia, 254.

VARICELLA, 109; care of mouth in, 113; control of itching in, 112; convalescence from, 113; definition of, 109; diet in, 113; eruption in, 112; hemorrhagic eruption in, 113; history of, 109; immunity conferred by attack of, 110; incubation period of, 110; itching in, 112; prophylaxis of, 111; susceptibility to, 110; synonyms for, 109; transmission of, 110; treatment of, 111.

VAUGHAN, isolation of tyrotoxin by, 617.

VAUGHAN AND McClymonds, work by, on bacteria present in cheese poisoning, 617.

Vegetable cathartics. See Cathartics.

VEGETABLE ORGANISMS, as a cause of food poisoning, 634.

VEGETABLE STARCH, substitutes for, in diabetes mellitus, 748.

Vegetables, use of, in anemia accompanying rachitis, 818; in diabetes mellitus, 744.

Venesection, use of, for elimination of toxic substances in intestinal auto-intoxication, 672; in pneumonia, 255; in pneumonia complicated with edema of the lungs, 259; in pneumonia in connection with inhalations of oxygen, 237.

- Veratrum viride**, use of, in pneumonia, 248; in pneumonia with abnormally high blood pressure, 255.
- Veronal**, use of, in delirium of pneumonia, 228; in delirium tremens, 606; for insomnia in acute rheumatism, 302; for insomnia in septicopyemia, 291; in scarlet fever, 127.
- VIDIUS**, distinction between chicken-pox and small-pox first made by, 109.
- VIENNOIS**, theory held by, that syphilis is transmitted only when the lymph is contaminated with blood, 88.
- VIPOND**, cases of glandular fever reported by, 576.
- VISCEROPTOSIS**, associated with autointoxication due to habitual constipation, 688.
- VON ERMEGEN**, epidemic of meat poisoning due to *B. botulinus* reported by, 638.
- VON NOORDEN**, levulose recommended by, in diabetic coma, 748; lists of diabetic food prepared by, 738; modification of Gerhard's test for acetone bodies suggested by, 733; oatmeal treatment of diabetes mellitus introduced by, 753; on over-rapid reduction of weight, 789; on physical therapy in treatment of obesity, 806; table by, showing how butter and oil can be added to vegetables in a diabetic diet, 743.
- VON NOORDEN'S "GREEN DAYS,"** 753.
- von Noorden's system**, for reduction of obesity, 794.
- VULVITIS, DIABETIC.** See Diabetic vulvitis.
- WAGNER, C.**, polymyositis first described by, 684.
- WALTHER, OTTO**, method of using exercise in tuberculosis employed by, 527.
- WASSERMANN**, discovery by, of specific serum reaction in syphilis, 362.
- WASSERMANN REACTION**, as test for syphilis, 379; value of, in question of marriage, 420.
- WATER, DRINKING**, bacillary dysentery transmitted by, 319; systemic poison due to, 634; typhoid fever transmitted by, 23.
- Water, drinking**, therapeutic value of, in acute rheumatism, 298; in bacillary dysentery, 325; in delirium tremens, 602; in gastrointestinal type of influenza, 190; in infantile diarrhea, 328; in nephritis complicating scarlet fever, 133; in pneumonia, 227; in Rocky Mountain fever, 564; in scarlet fever, 125; in septicopyemia, 290; in typhoid fever, 14.
- WATERCRESS**, poisoning by, 651.
- WATER HEMLOCK.** See *Cicuta* roots.
- WATERHOUSE, DR. BENJAMIN**, early work in vaccination by, 61; experiments by, on inoculation for small-pox, 92.
- WEIGERT**, *Cytoryctes variolæ* first described by, 41.
- WEIGHT OF BODY.** See Body weight.
- WEIL'S DISEASE**, 570; convalescence from, 573; diet in, 571; general treatment of, 571; medication in, 572; muscular pains in, 572; nephritis complicating, 572; prognosis in, 570; prophylaxis against, 570; treatment of, in general, 570.
- WELANDER'S MERCOLINT APRONS**, 390.
- WELCH AND SCHAMBERG**, incision of conjunctiva in small-pox advised by, 50; investigation by, on revaccination, 76; prognostic value of vaccination scars investigated by, 75; silver nitrate in care of eyes in small-pox advised by, 50; on treatment of eruption in small-pox, 48, 50.
- WEST**, cases of glandular fever reported by, 574, 575; on use of calomel in treatment of, 576; mortality from, in cases reported by, 577.
- "WET BRAIN,"** occurrence of, in delirium tremens, 608.
- WET NURSES**, syphilis communicated by or to, 374.
- WHITE**, case of mumps six days after birth reported by, 167; method of measuring tolerance to tuberculin proposed by, 520.
- White precipitate ointment**, use of, in hereditary syphilis, 434; in macular and papular syphiloderms, 425; in pustular and ulcerative syphiloderms, 426; in syphilitic onychia, 429; in uncomplicated chancre, 422.
- WHOOPING-COUGH**, 173; administration of drugs in, 180; antitoxic serum for, 183; breathing compressed air in, 179; as a complication of measles, 161; complications in, 175; definition of, 173; diet for, 179; disinfection of patient's room in, 179; drugs beneficial in, 180, 181; etiology of, 173; external use of drugs in, 180; history of, 173; hygienic measures in,

- 177; hypodermic use of drugs in, 180, 181; immunity conferred by, 175; incubation period in, 175; inhalation of drugs in, 180; internal use of drugs in, 181; mechanical measures for relief of cough in, 178; misuse of drugs for, 175; mortality from, 175; mortality from bronchopneumonia complicating, 175; organism causing, 174; as predisposing cause of rachitis, 814; prophylaxis in, 176; psychic treatment of, 178; rectal feeding in, 180; stages in, 175; symptoms due to misuse of drugs in, 175; synonyms for, 173; transmission of, 174; treatment of, 177; vaccination for small-pox and its influence upon, 74, 179; vaccines and their possibilities in the treatment of, 183.
- WILDER, R. M.**, work by, on transmission of typhus fever, 32.
- WILLIAMSON**, method of preparing milk, suggested by, for use in diabetes mellitus, 742.
- WILLIS, THOMAS**, sweet character of diabetic urine, first noted by, 717; whooping-cough first recognized by, in England, 173.
- Wintergreen oil**, use of, externally, to relieve pain in the chest accompanying tuberculosis, 506.
- WOOD, DR. ALEXANDER**, hypodermic needle invented by, 617.
- WOOD ALCOHOL POISONING, ACUTE**, 609; treatment of, 610.
- WOOD NAPHTHA.** See Wood alcohol.
- WOOD TICK**, transmission of Rocky Mountain fever by, 562, 563.
- WOODRUFF, MAJOR**, exposure to direct sun rays believed to be injurious by, 459.
- WOODWARD, DR.**, first communication regarding inoculation for small-pox made by, 52.
- WOOLSORTERS' DISEASE**, 331.
- WORKSHOPS**, disinfection of, in tuberculosis, 453.
- WRIGHT, SIR ALMROTH**, theories of, concerning autoinoculation in tuberculosis, 525; use of calcium preparations for control of hemorrhage introduced by, 155.
- WURTZEN**, on red light treatment of small-pox, 51.
- Wyss**, investigation by, of epidemic among fish, 644.
- XANTHOMA DIABETICORUM**, as a symptom of diabetes mellitus, 765.
- Xeroform**, use of, as dusting powder, in gangrenous chancre, 423; in mucous patches upon the genitalia, 427; in papular or tubercular tertiary lesions of syphilis, 426; use of vaginal tampons impregnated with, in chancre of the vagina or the uterine neck, 425.
- X-ray**, use of, in delayed resolution of pneumonia, 258; in treatment of chronic influenza, 195; to determine the site of arterial obstruction in diabetic gangrene, 770.
- X-ray therapy**, use of, in arthritis deformans and chronic rheumatism, 713; in diabetes mellitus complicating thyroid disease, 767; to prevent acidosis in diabetes mellitus, 757; in pruritus accompanying diabetes mellitus, 765.
- YAMS**, certain species of, dangerous as food, 651.
- Yeast**, internal use of, in diabetes mellitus, 761; to relieve boils complicating diabetes mellitus, 765.
- Yeast**, local use of, to relieve pruritis vulvæ in diabetes mellitus, 765.
- YEO, BURNEX**, salicin recommended by, in acute rheumatism, 300.
- Yeo mask**, inhalations by means of, to relieve cough in pulmonary tuberculosis, 497.
- Yohimbin**, use of, in impotence accompanying diabetes mellitus, 766.
- YOUTH**, protection against tuberculosis in, 462.
- Zander machine**, use of, in treatment of obesity, 807.
- ZEISTS**, 657.
- Zinc oxid**, use of, as dusting powder, in diabetic vulvitis, 765.
- Zinc oxid ointment**, use of, in diabetic vulvitis, 765; use of, as a protection in counter-irritation in bronchopneumonia, 159.
- Zinc sulphate**, use of, to unload stomach in acute opium poisoning, 614.

